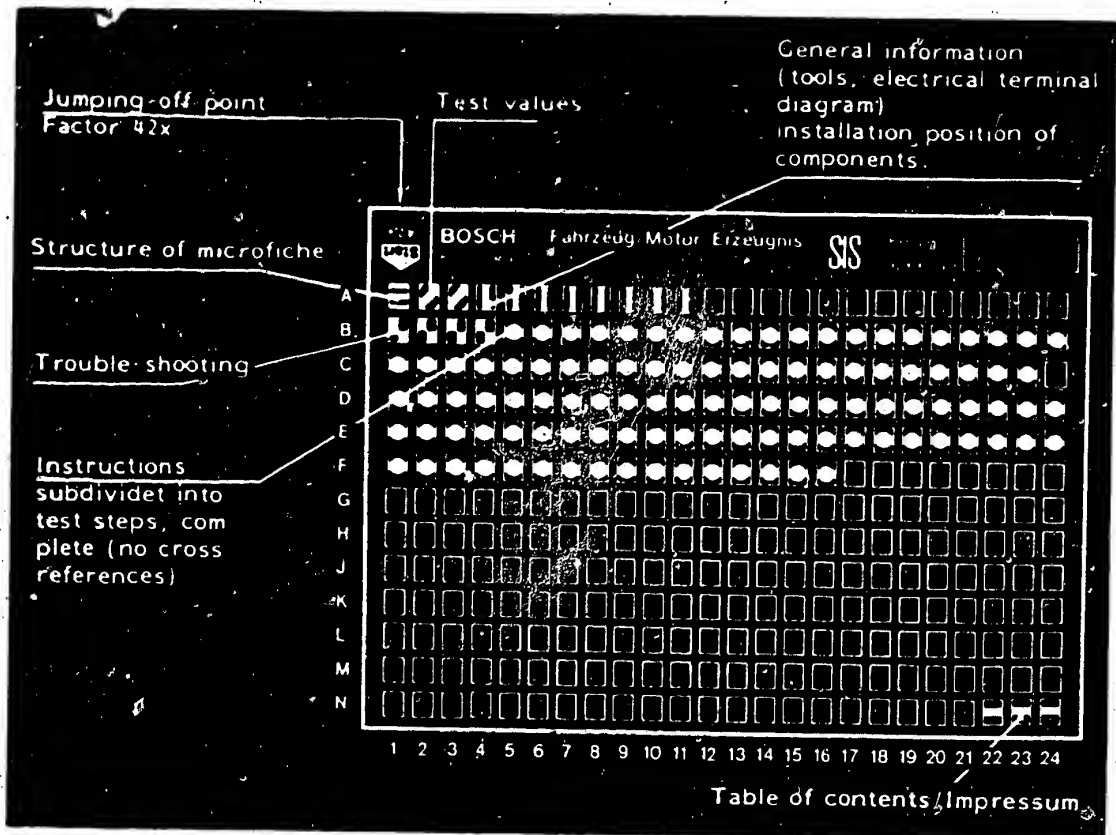


# Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

<b>E16</b>	Product/componer	test step
	Vehicle/engine	

↑ Coordinate

3. Limits of section



4. References to relevant test steps in test specifications; coordinate e.g. C6

**C6**

<b>A1</b>	Trouble-shooting program	
-----------	--------------------------	--

## 1. Test specifications

1.1 Idle speed: 700 + 30 min<sup>-1</sup>

**C8**

1.2 Nozzle opening pressure: 170 bar

**C9**

1.3 Filter test

max. allowable

differential pressure: 0.3 bar

**C13**

1.4 Compression loss: max. allowable 25 %

**D5**

1.5 Injection timing:

**F2**

Engine position:

Cylinder 1 at IDC

Setting value

Pump position:

0.90 mm ABDC

1.6 Charge-air pressure: 0.87 bar

1.7 Compression pressure: approx. 22 bar

**A2**

Test specifications

Fiat Argenta 2500 Turbo-Diesel



### 1.8 Tightening torques

Fuel-injection pump gear  
(Hex nut)

98 Nm

Fuel lines

25 Nm

Fastening screws for the  
fuel-injection pump

25 Nm

Screw plug

10 Nm

Fastening screws for  
nozzle-holder assembly

49 Nm

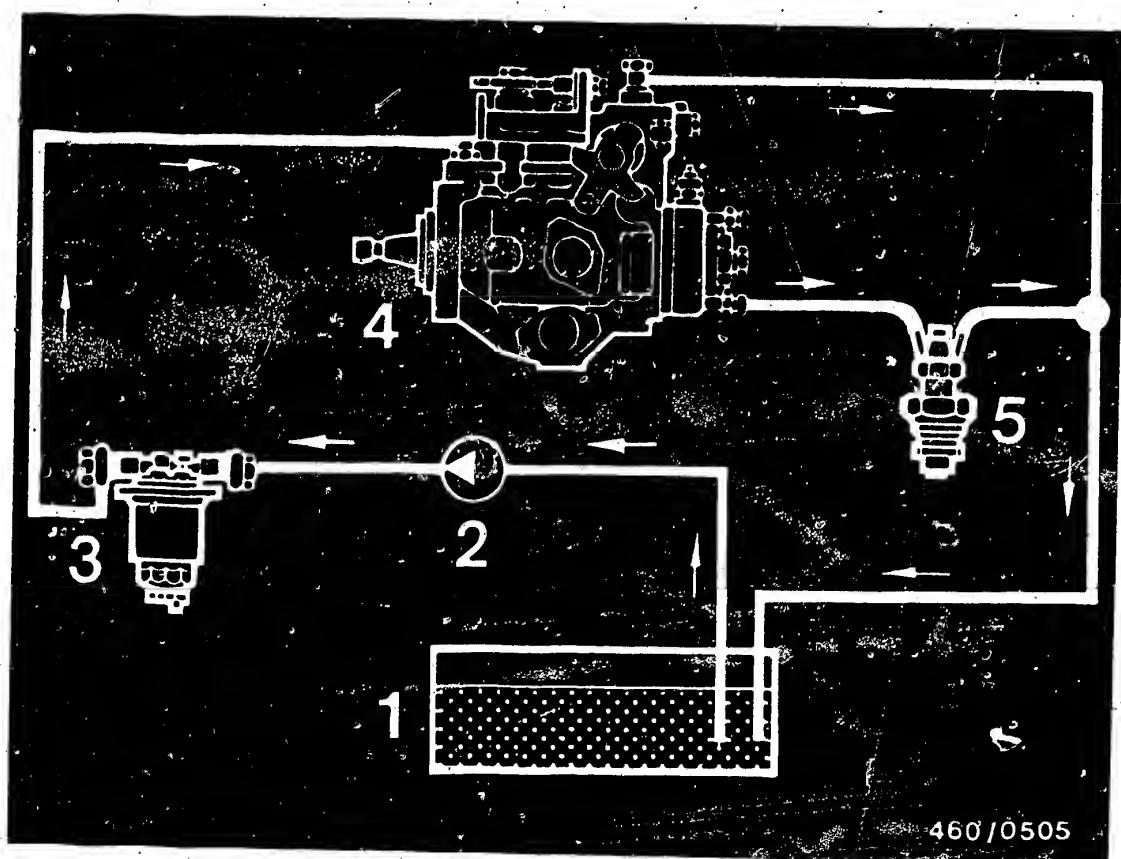
Sheathed-element glow plugs

15 Nm

Fastening nuts for the  
intake/exhaust manifolds

25 Nm





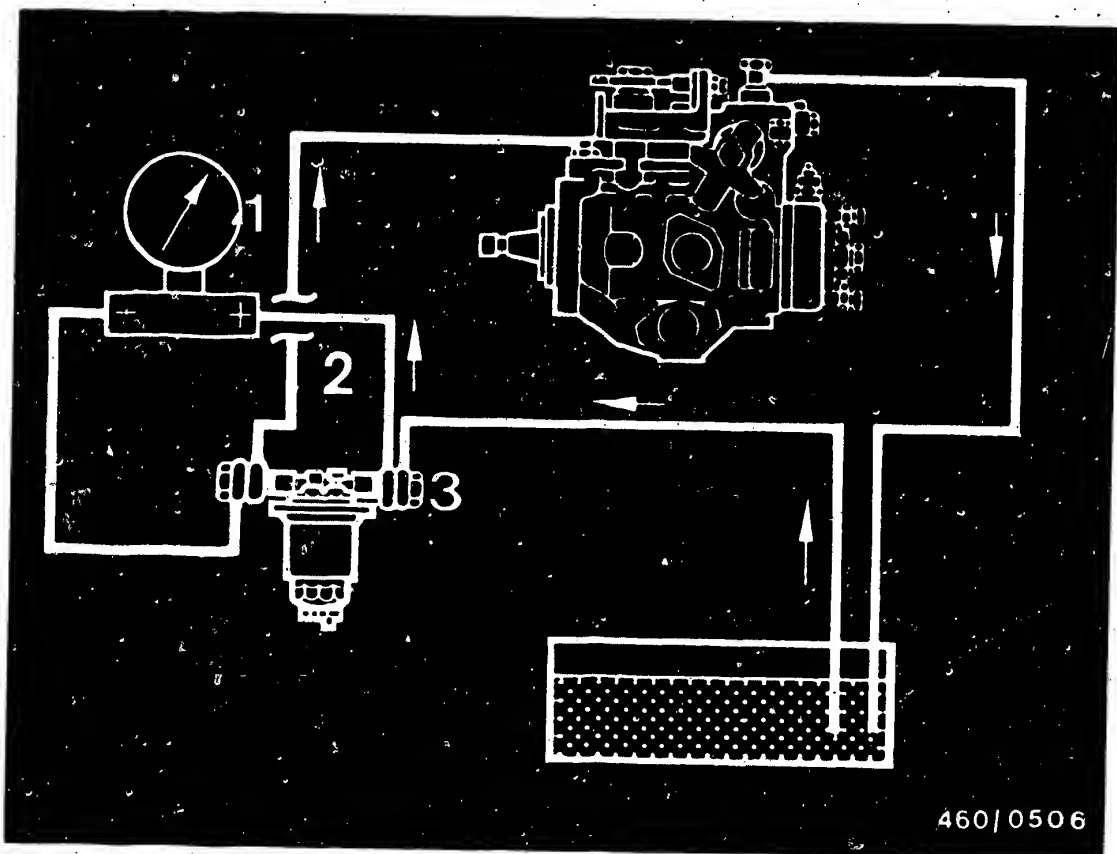
- |                          |                                     |
|--------------------------|-------------------------------------|
| 1 = Fuel tank            | 3 = Fuel filter                     |
| 2 = Fuel pre-supply pump | 4 = Distributor-type injection pump |
|                          | 5 = Injection nozzles               |

## 2. Diagram of fuel lines

The fuel lines are connected according to the above diagram.

The fuel flows in the direction of the arrows.



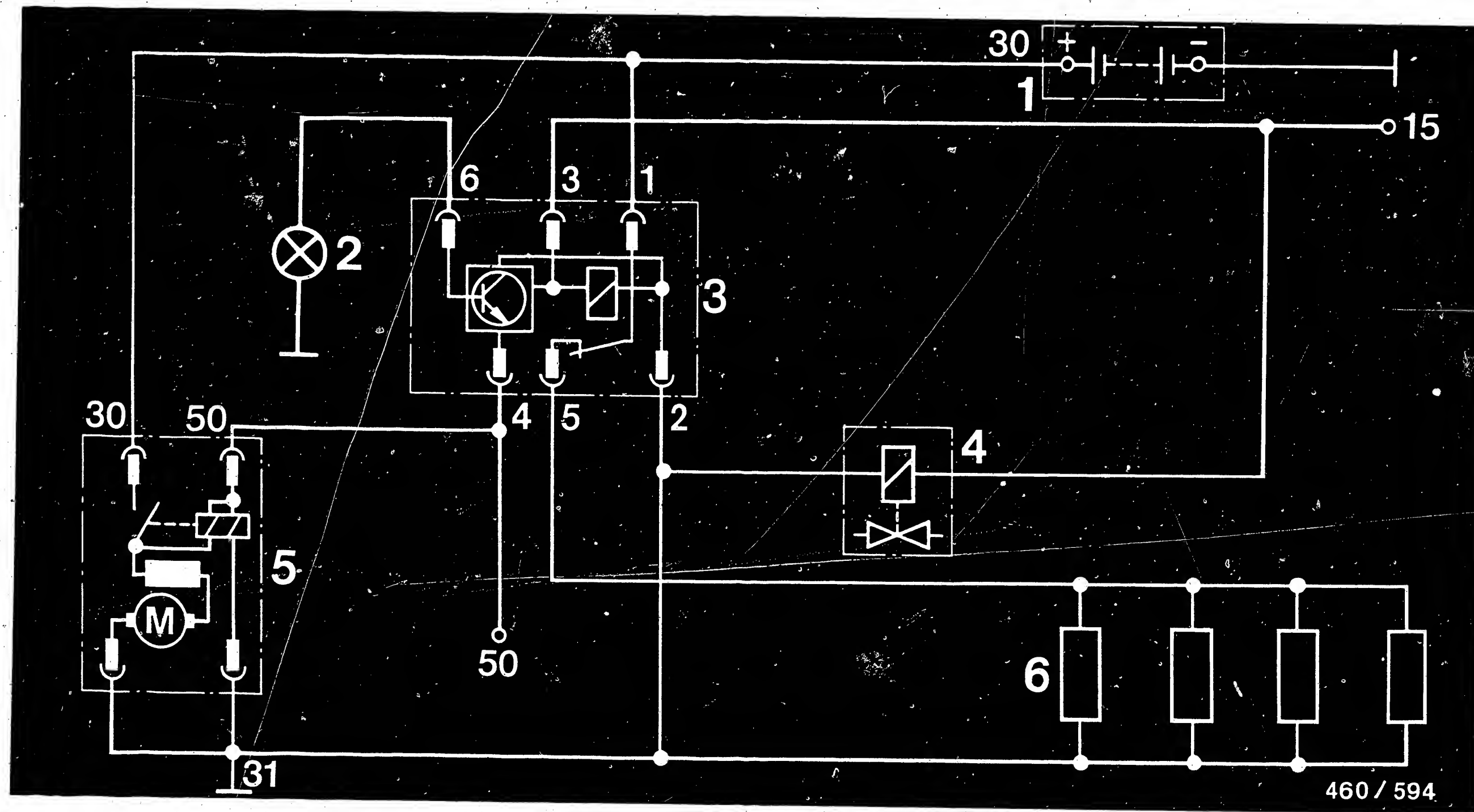


- 1 = Differential-pressure gauge
- 2 = Filter outlet  
(Use inlet union and extra-long inlet-union screw 2 443 456 020)
- 3 = Filter inlet  
(Use inlet union and extra-long inlet-union screw 2 443 456 020)

### 2.1 Connection diagram for filter test

Connect differential-pressure gauge to fuel filter using appropriate connecting parts.





1 = Battery  
2 = Glow-plug indicator lamp

3 = Glow-duration unit  
4 = Solenoid-operated valve

5 = Starting motor  
6 = Sheathed-element glow plugs

3. Connection diagram for preheating system

**A6**

Connection diagram - preheating system  
Fiat Argenta 2500 Turbo-Diesel



**A7**

Connection diagram - preheating system  
Fiat Argenta 2500 Turbo-Diesel



460 / 594

#### 4. Test equipment and tools

Designation	Part No.	Use
box wrench	KDEP 1115	Loosening/ tightening fuel- injection lines
Measuring tool	KDEP 1085	Injection timing
Mini-dial indicator graduation 1/100 mm	Commercially available, e.g. Hahn & Kolb /000 Stuttgart Part No. 33 0003 with adapter KDEP 1127	Injection timing
Pressure tester or pressure gauge 0...1.6 bar	KDJE-P 100 e.g., Wika No. 4 184	Testing charge- air pressure
Locating pin	User-fabricated	Fixing fuel- injection pump gear/crankshaft pulley in place

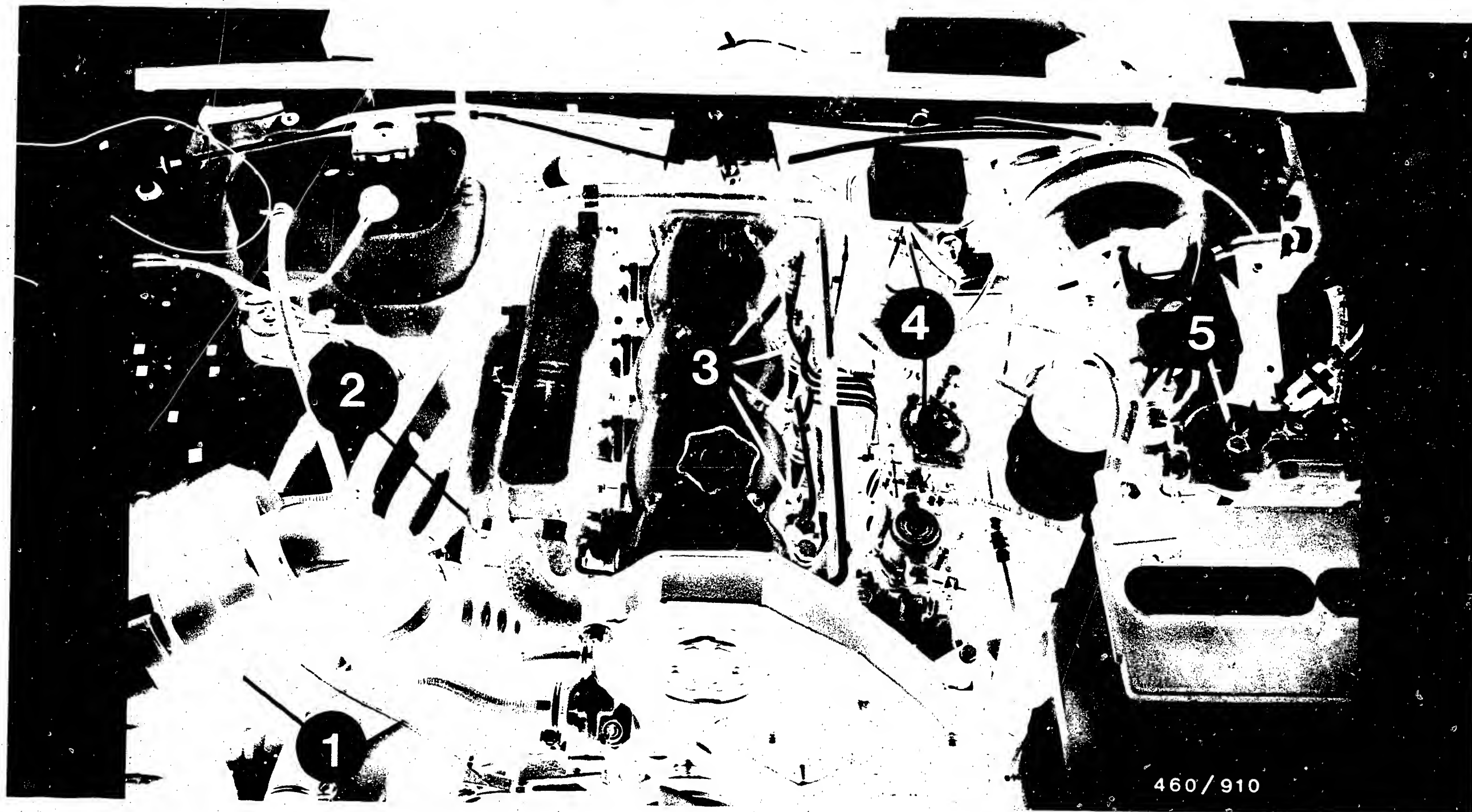


# Test equipment and tools (continued)

Designation	Part No.	Use
Nozzle tester	EFEP 60 H O 681 200 502	Testing fuel-injection nozzles
Compression tester	Commercially available	Testing engine compression
Compression loss tester	EFAW 210 A O 681 001 901	Testing engine compression loss
Tachometer	Commercially available e.g., Dr. E. Horn GmbH Meßgerätefabrik Postfach 40 7036 Schönaich Part No: HT 446 (with digital display)	Adjusting engine speed
Differential pressure gauge	Commercially available Part No. NG 160/311-911 -1.0 + 4.0 bar Firma Henni Nauheimer Str. 78-80 7000 Stuttgart 50	Testing filter
Smoke tester Accessory box with metering pump	O 684 102 050 O 681 169 038	Smoke test







1 = Air filter    2 = Turbo-charger    3 = Fuel-injection nozzles    4 = Fuel-injection pump    5 = Fuel filter

5. Installation position of the components in the Fiat Argenta Turbo Diesel (after 06.83)

**A10**

Installation position of the components  
Fiat Argenta 2500 Turbo-Diesel



**A11**

Installation position of the components  
Fiat Argenta 2500 Turbo-Diesel



# 6. Trouble-shooting - Customer complaint (symptom)

1. Engine fails to start or starts only with great difficulty when warm.
2. Engine fails to start or starts only with great difficulty when cold.
3. Engine hunts when idling.
4. Erratic idling when engine is warm.
5. Engine misses during vehicle operation.
6. Unsatisfactory performance.

						Cause (component fault)	Coordinate
●	●			●	●	Tank empty; tank vent clogged	B 5
	●					Cold-start accelerator not actuated	B 6
	●		●			Injection sequence does not correspond to firing sequence	B 7
				●		Overflow restriction clogged	B 8
●	●					Shutoff device defective	B 9
		●		●	●	Inlet-union screws of inlet and return lines clogged	B 12
●	●		●	●	●	Air in fuel system	B 14
	●					Heavy paraffin deposits in filter	B 16
●	●			●	●	Connections loose; lines leaky or broken	B 19
●	●			●	●	Supply lines clogged	B 22
●	●			●	●	Fuel-injection tubing clogged or constricted	B 22
					●	Engine air filter clogged	B 23
			●			Idle speed incorrect	C 8
●	●		●		●	Injection nozzle defective	C 9
	●		●		●	Start of pump delivery incorrect	F 2
●	●			●	●	Fuel filter clogged	C 13
	●					Pre-heating system defective	C 16
					●	Timing device defective	D 4
	●		●			Engine compression poor or uneven	D 5
					●	Maximum speed incorrectly adjusted	D 15
●	●	●	●	●	●	Fuel-injection pump (governor) defective or out of adjustment	D 15
					●	Test turbocharger for leaks and test charge-air pressure	F 10

**B1**

Trouble-shooting chart

Fiat Argenta 2500 Turbo-Diesel



**B2**

Trouble-shooting chart

Fiat Argenta 2500 Turbo-Diesel



# Trouble-shooting (continued) - Customer complaint (symptom)

7. Excessive fuel consumption.

8. Engine cannot be swtched off.

9. Engine runs rough, black smoke in full-load range; possibly lack of power.

10. Fog-like smoke in full-lead range (white).

11. Incorrect engine speeds.

12. Engine will not rev up when cold.

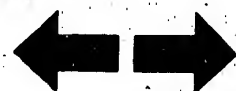
13. Distributor-type fuel-injection pump becomes too hot.

							Cause (component fault)	Coordinate
			●		●		Tank empty; tank vent clogged	B 9
					●		Cold-start accelerator not actuated	B 6
		●		●	●		Injection sequence does not correspond to firing sequence	B 7
						●	Overflow restriction clogged	B 8
	●						Shutoff device defective	B 9
			●	●	●		Inlet-union screws of inlet and return lines clogged	B 12
			●		●		Air in fuel system	B 14
					●		Heavy paraffin deposits in filter	B 16
●							Connections loose; lines leaky or broken	B 19
			●		●		Supply lines clogged	B 22
			●		●		Fuel-injection tubing clogged or constricted	B 22
		●					Engine air filter clogged	B 23
				●			Idle speed incorrect	C 8
		●					Injection nozzle defective	C 9
●		●	●		●		Start of pump delivery incorrect	F 2
			●		●		Fuel filter clogged	C 13
		●	●				Timing device defective	D 4
●					●		Engine compression poor or uneven	D 5
				●			Maximum speed incorrectly adjusted	D 15
●	●	●	●	●	●	●	Fuel-injection pump (governor) defective or out of adjustment	D 15

**B3**

Trouble-shooting chart

Fiat Argenta 2500 Turbo-Diesel

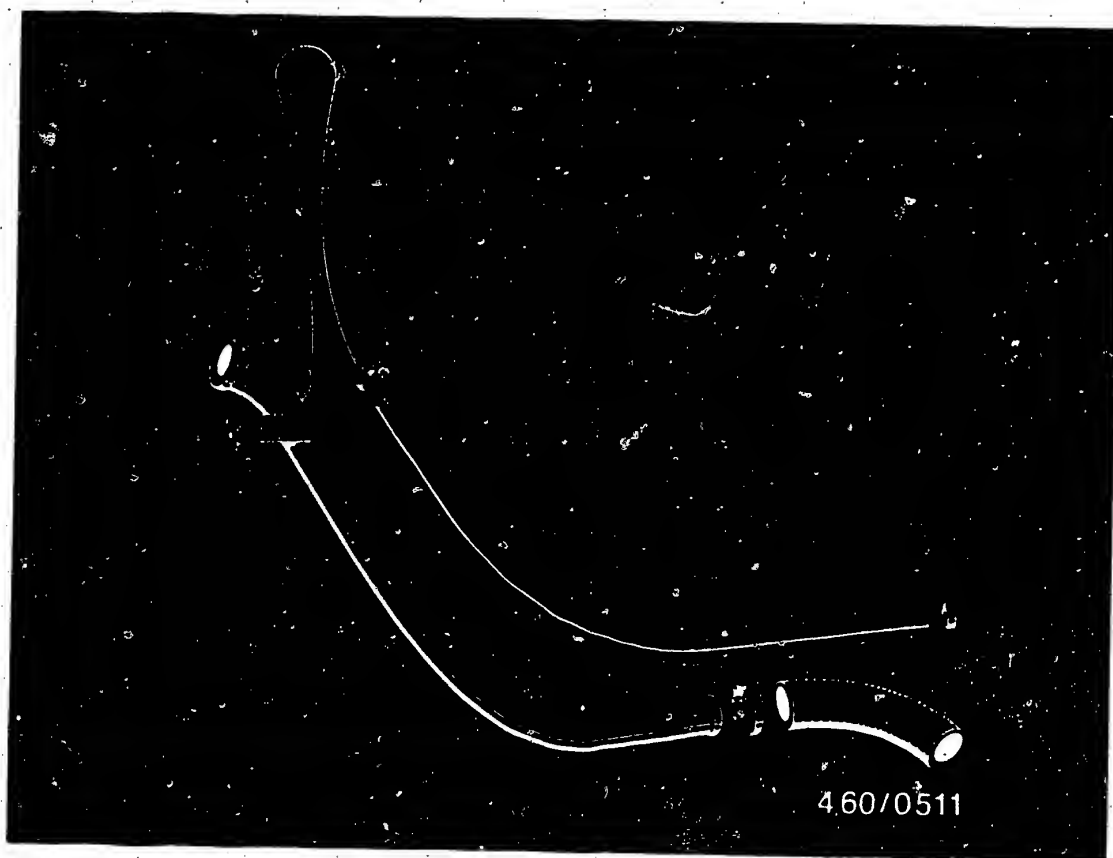


**B4**

Trouble-shooting chart

Fiat Argenta 2500 Turbo-Diesel





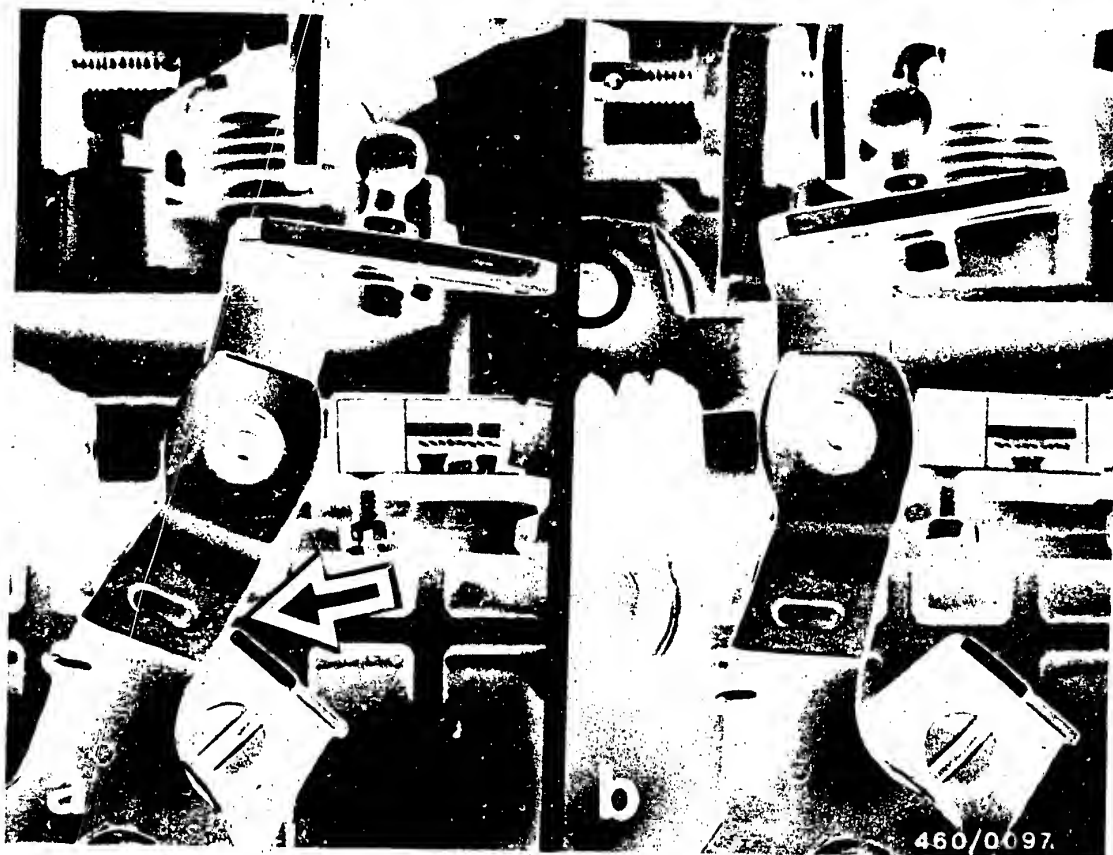
### 7. Check tank vent

Open tank filler cap.

If the fault disappears after opening the filler cap, the tank vent is defective.

Remove tank-vent hose lines (picture) and check for clogging or constriction.

If necessary, check fitting on tank.



#### 8. Test operation of tempoerature-controlled cold-start accelerator

If the cold-start accelerator is correctly set, with the engine at normal operating temperature (coolant temperature approx. 80°C) the control lever of the cold-start accelerator must be up against the stop bracket (picture a - arrow).

When the engine is cold, the control lever of the cold-start accelerator has reached its maximum working stroke (picture b).

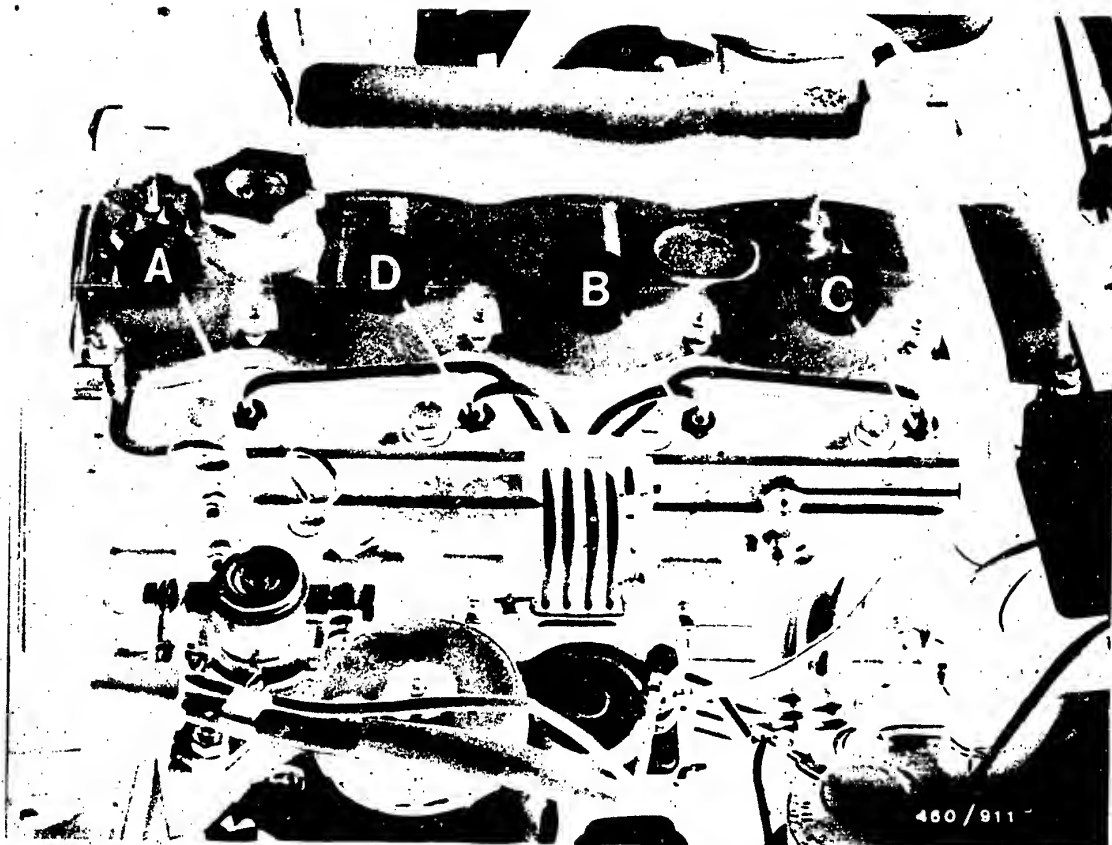
If, when cold, the control lever remains up against the stop bracket or makes only a short stroke, it is necessary to remove and reset the injection pump.

**B6**

Test cold-start accelerator

Fiat Argenta 2500 Turbo-Diesel





#### 9. Check routing of fuel-injection tubing

The fuel-injection lines are joined together by clamps so that it is impossible to mix up the outlets.

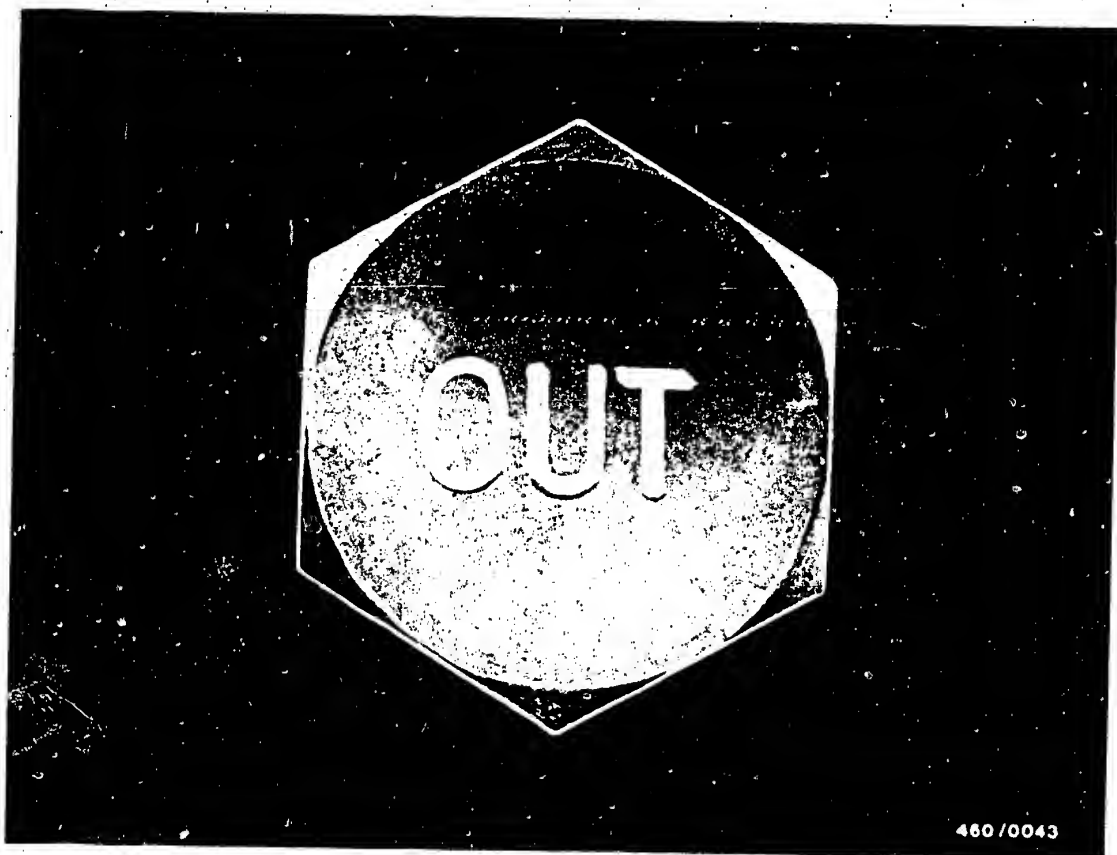
If, however, there is any doubt, check the routing of the lines as shown in the picture above.

The pairing of the fuel-injection pump outlets with the individual engine cylinders is identified by the letters A - D.

**B7**

Check routing of fuel-injection tubing  
Fiat Argenta 2500 Turbo-Diesel





10. Check overflow restriction

Unscrew overflow restriction on fuel-injection pump (marked "out").

Perform visual inspection of wire screen for impurities. If in doubt, replace overflow restriction.

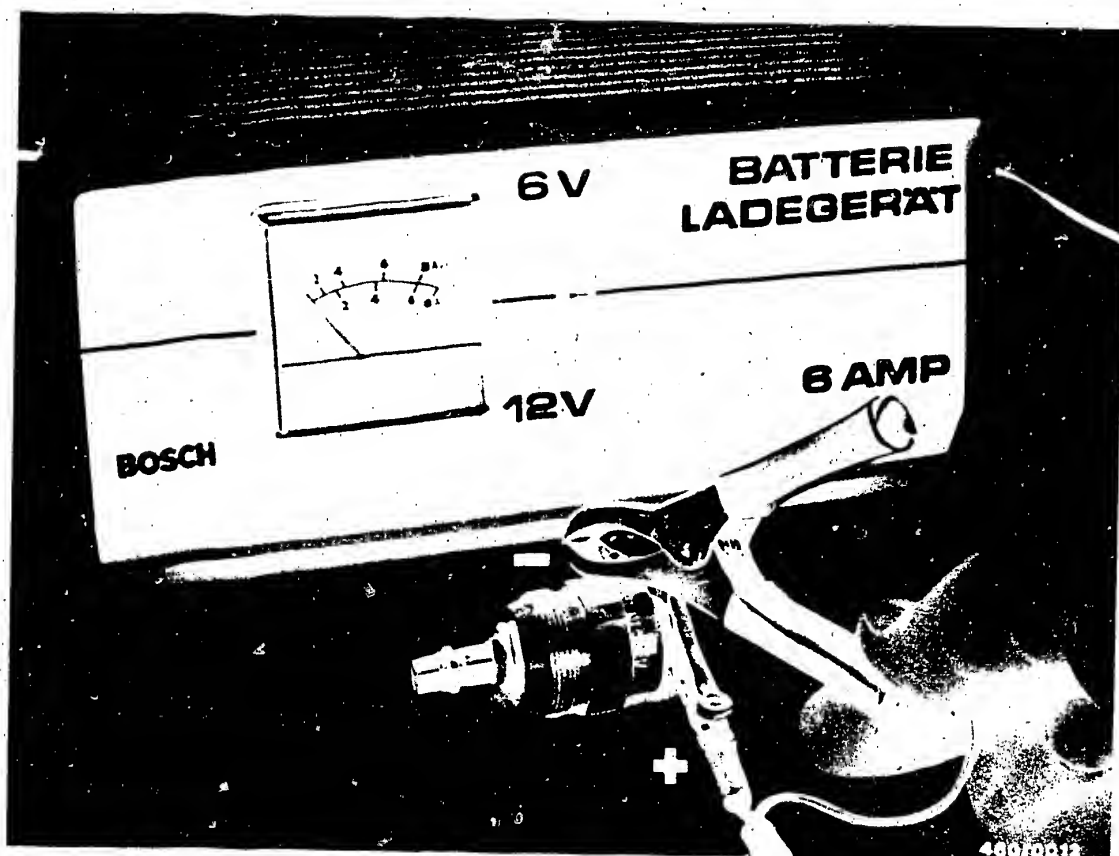
**B8**

Check overflow restriction

Fiat Argenta 2500 Turbo-Diesel







## 11. Check operation of shutoff device

### 11.1 Engine fails to start

Check whether solenoid-operated valve is supplied with voltage (min. 10 V) with glow-plug and starter switch switched on (drive position).

If voltage is present, remove fuel-injection tubing and take out solenoid-operated valve.

Cleanliness is essential.

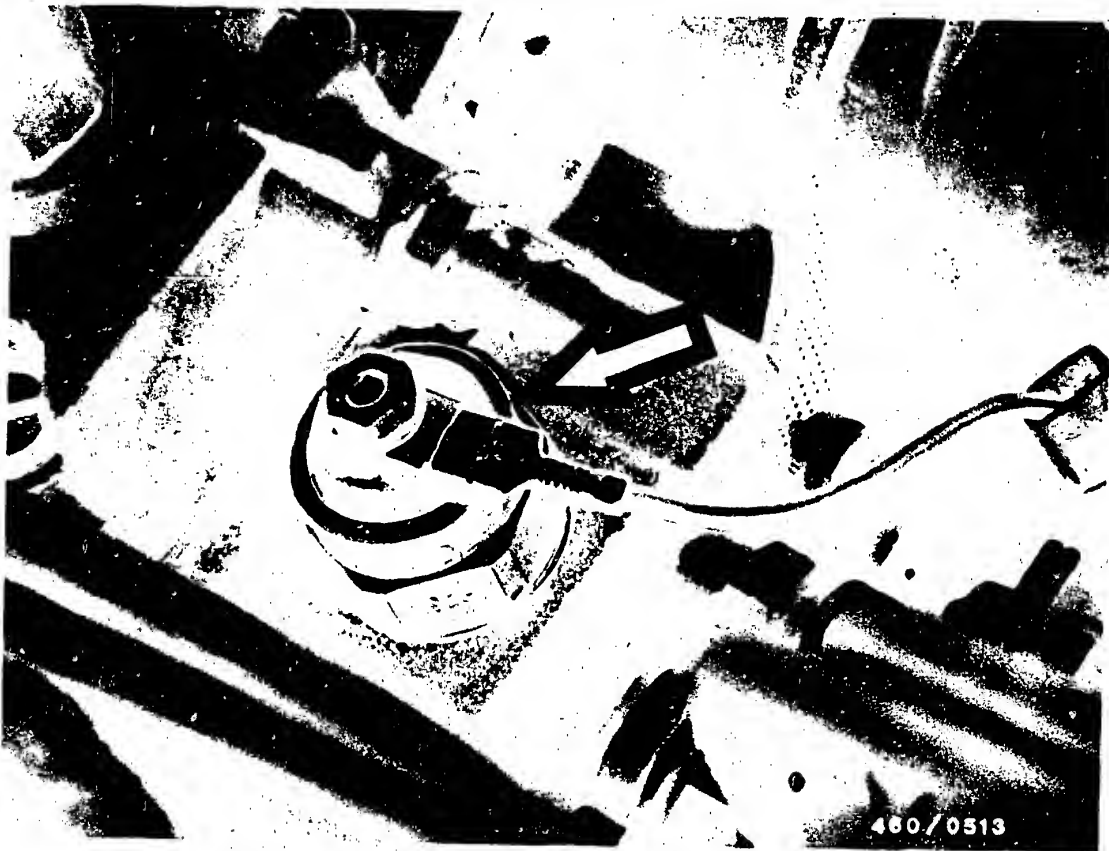
When removed, check operation of solenoid-operated valve.

#### Note:

When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.







### 11.2 Engine can not be switched off

With the glow-plug and starter switch in the stop position there must be no voltage across the solenoid-operated valve, i.e. the fuel inlet to the distributor-pump plunger is interrupted.

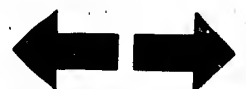
If the engine runs on, although there is no voltage across the solenoid-operated valve, the engine can be switched off as follows:

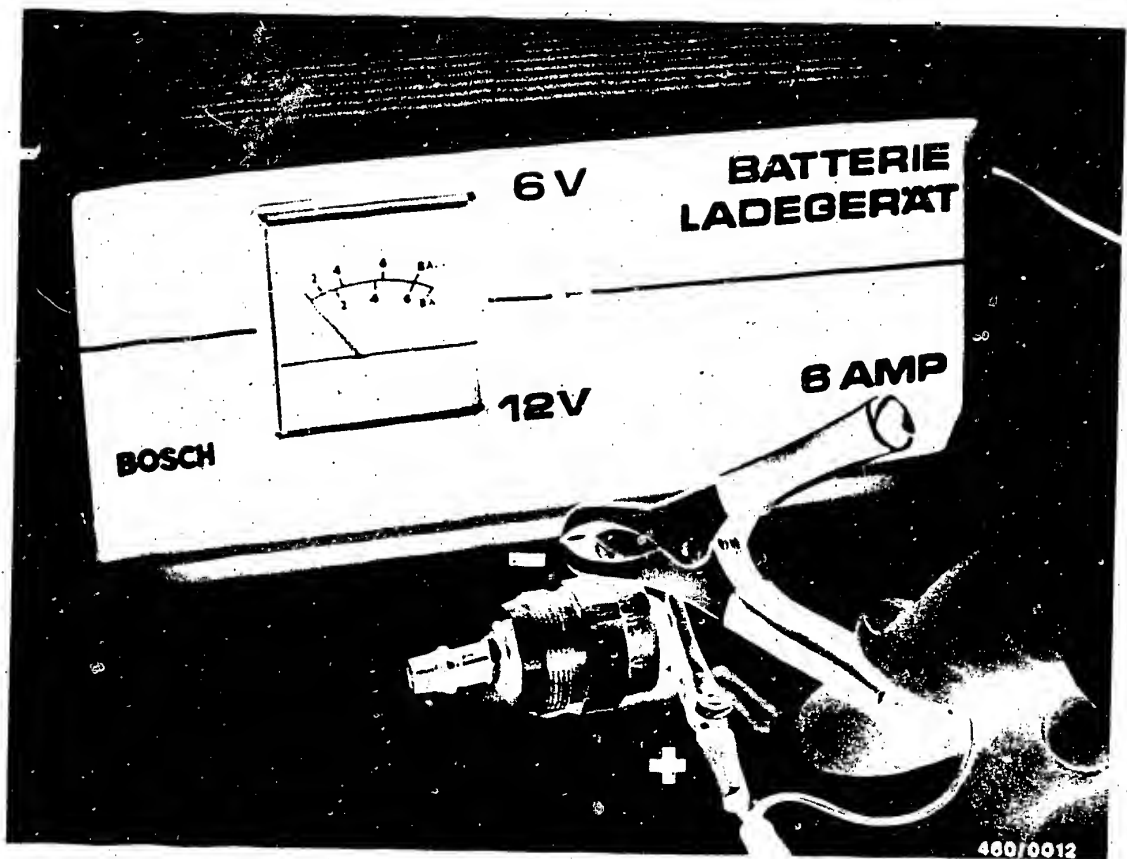
Select 3rd or 4th gear.  
Jam on footbrake and  
let out the clutch

**B 10**

Check shutoff device

Fiat Argenta 2500 Turbo-Diesel





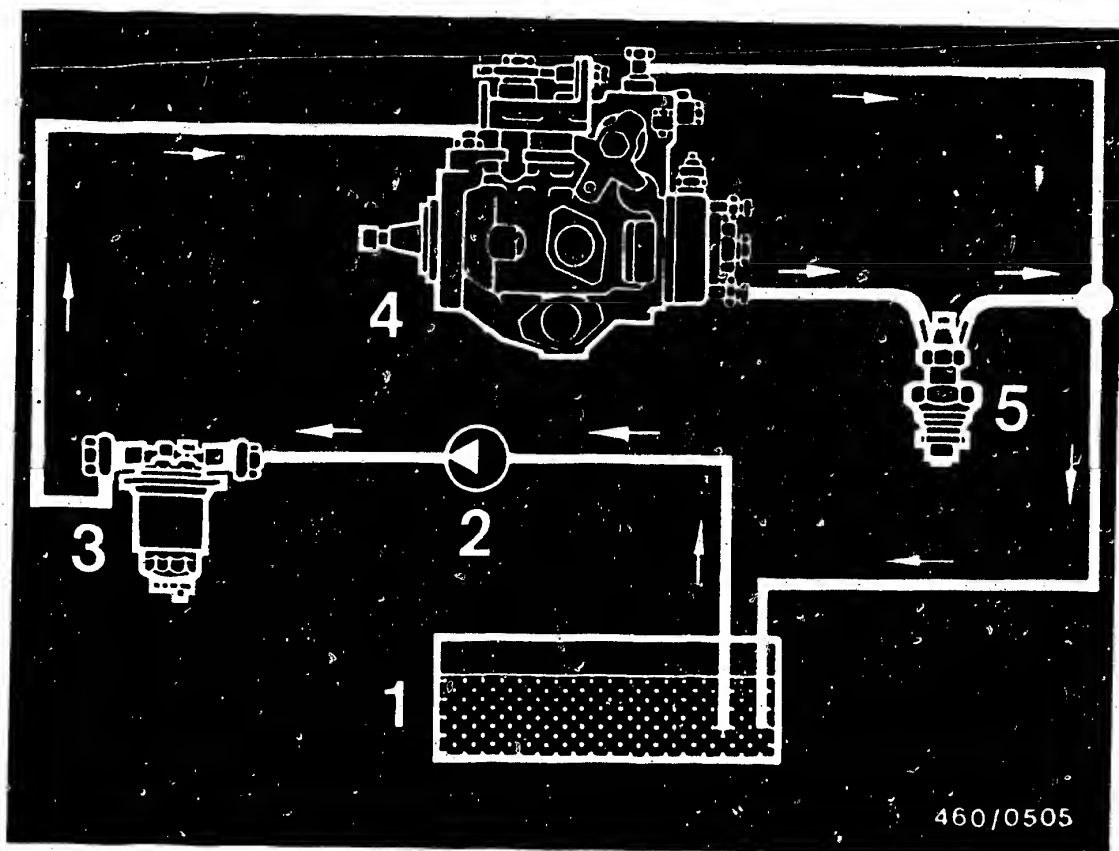
### 11.3 Solenoid-operated valve test

Remove fuel-injection tubing.  
Take out solenoid-operated valve.  
Cleanliness is essential.

When removed, check operation of solenoid-operated valve.

#### Note:

When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.  
Check valve seat in hydraulic head (visual inspection).



460/0505

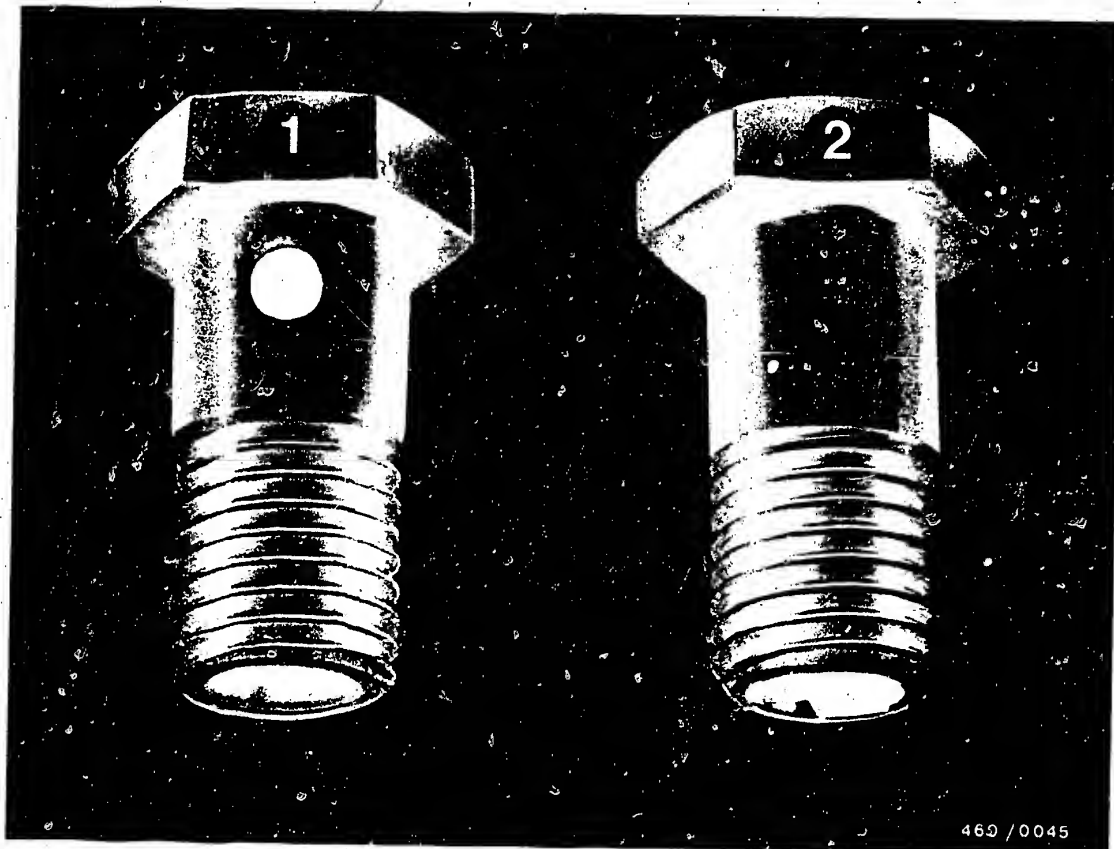
- 1 = Fuel tank
- 2 = Fuel pre-supply pump
- 3 = Fuel filter
- 4 = Distributor-type injection pump
- 5 = Injection nozzles

## 12. Diagram of fuel lines

The fuel lines are connected as shown in the above diagram.

The fuel flows in the direction of the arrows.





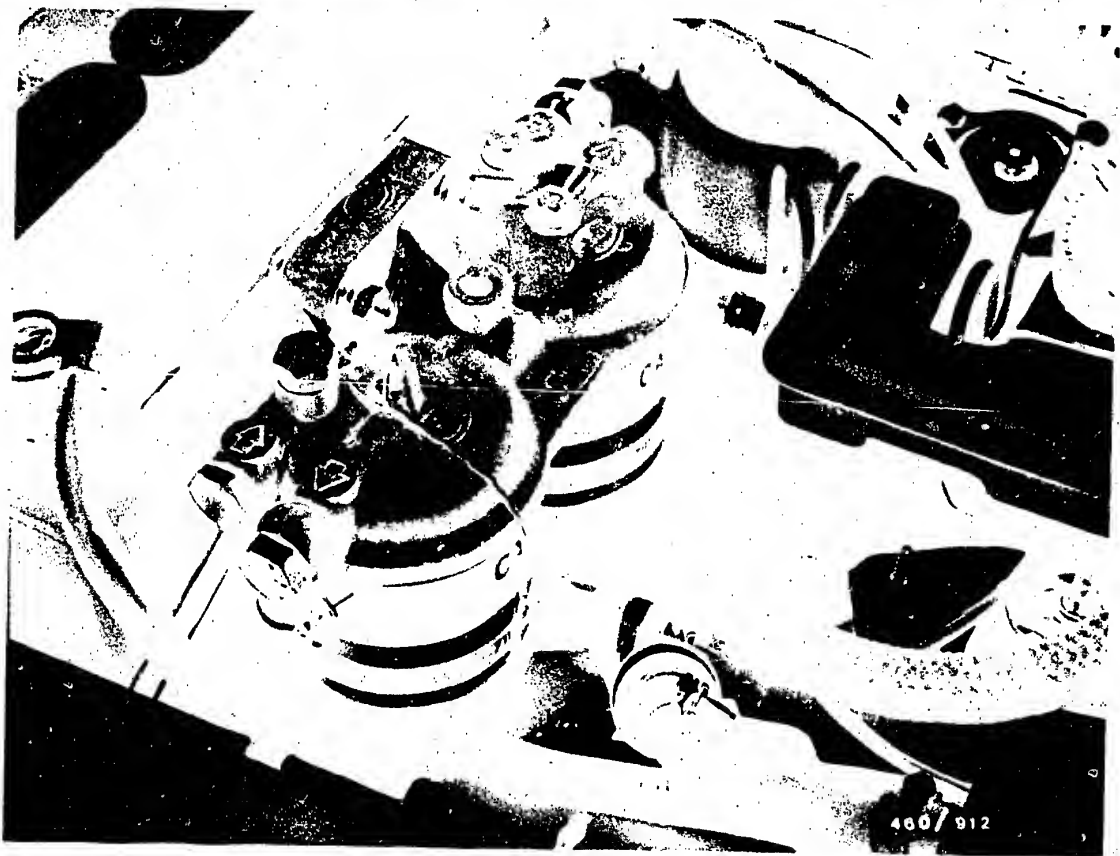
As regards the connections to the fuel-injection pump, ensure that the inlet-union screw for fuel inlet (1) and the throttle screw for fuel return (2) are not mixed up.

The throttle screw is located on the cover of the fuel-injection pump and the head of the screw is marked with the word "out".

**B 13**

Connection diagram of fuel lines  
Fiat Argenta 2500 Turbo-Diesel





### 13. Bleed fuel system

Fill the fuel filter and injection pump with diesel fuel.

Tighten hose connections on filter cover.

**B14**

Bleed fuel system

Fiat Argenta 2500 Turbo-Diesel





Loosen union nuts of fuel-injection tubing on nozzle-holder assemblies.

Operate starting motor without preheating until fuel escapes from union nuts of nozzle-holder assemblies (arrow).

Tighten union nuts.

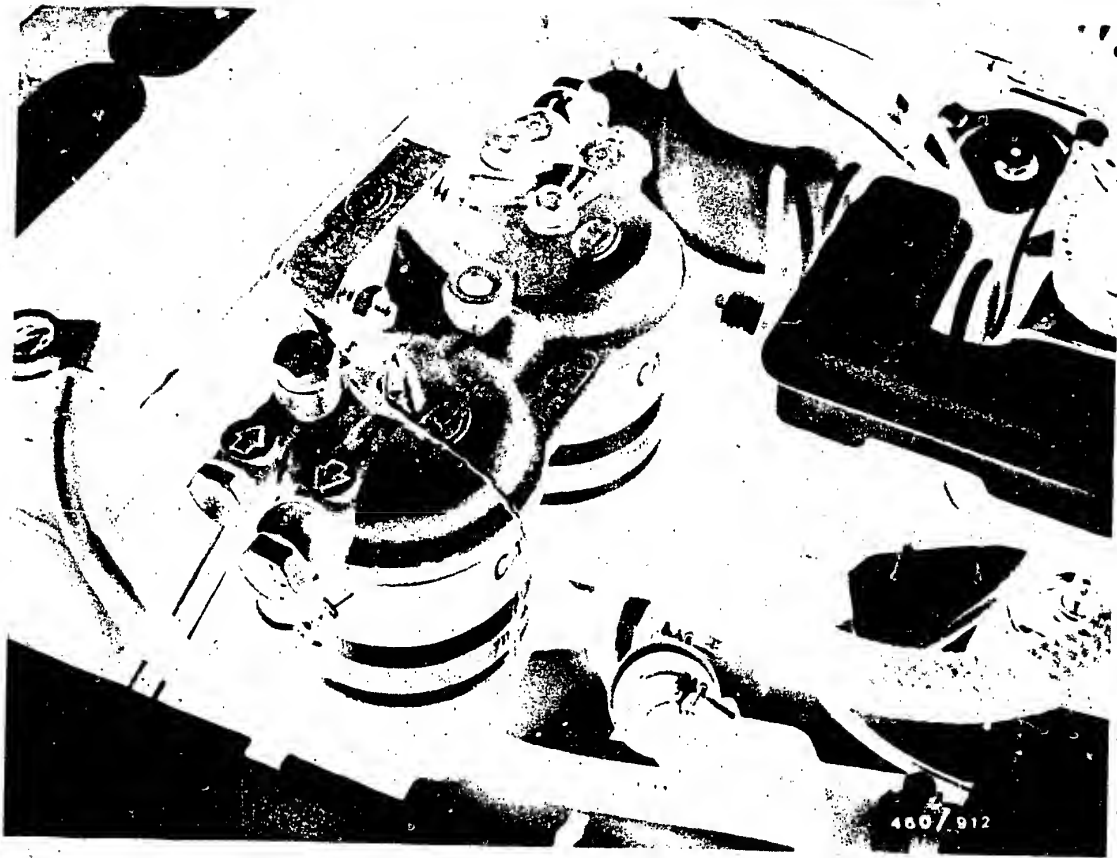
Operate starting motor until engine starts.

**B 15**

Bleed fuel system

Fiat Argenta 2500 Turbo-Diesel





14. Replace and drain water from filter box

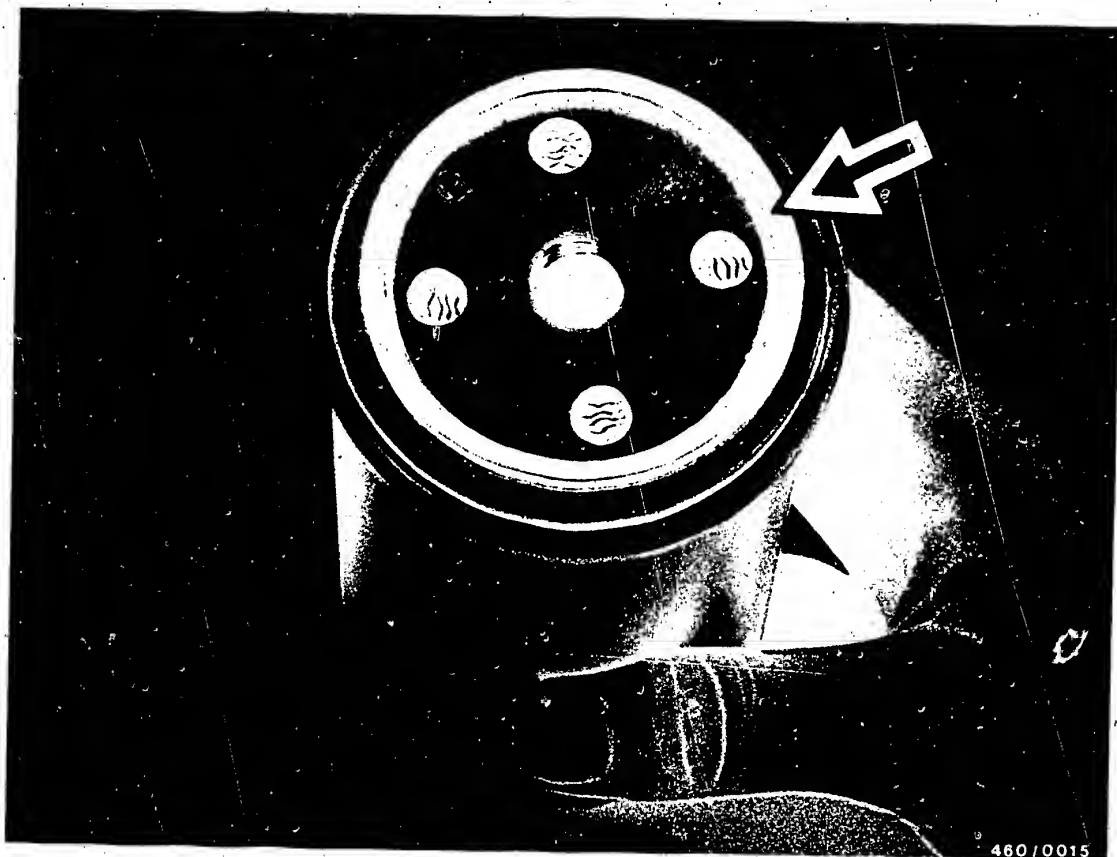
14.1 Replace filter box

Unscrew filter box and drain.

**B 16**

Replace and drain fuel filter  
Fiat Argenta 2500 Turbo-Diesel





460/0015

Rub diesel fuel into the rubber seal (arrow) of the new filter box.

Screw the filter box into the cover by hand and tighten.

Check the fuel filter for leaks.

In the case of winter fuel it may be necessary to add petroleum as specified by the vehicle manufacturer.

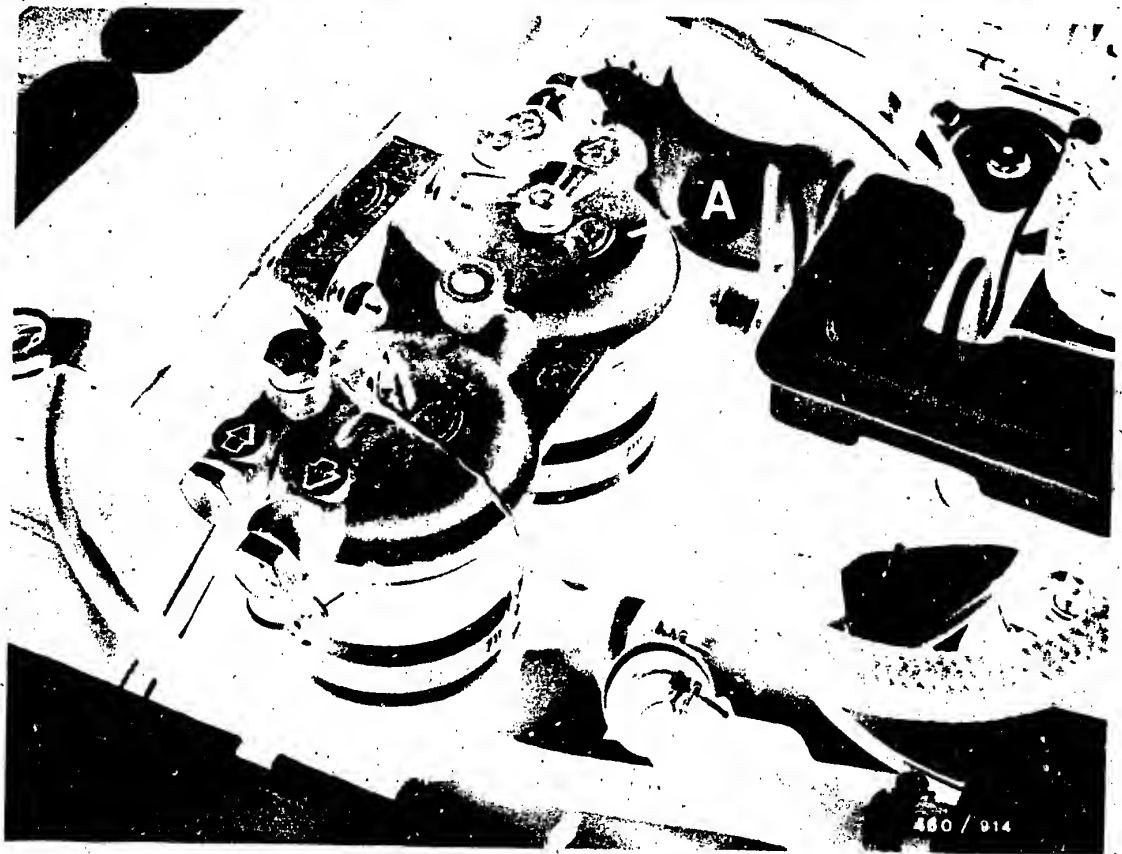
**B17**

Replace and drain filter box

Fiat Argenta 2500 Turbo-Diesel







#### 14.2 Drain water from fuel filter

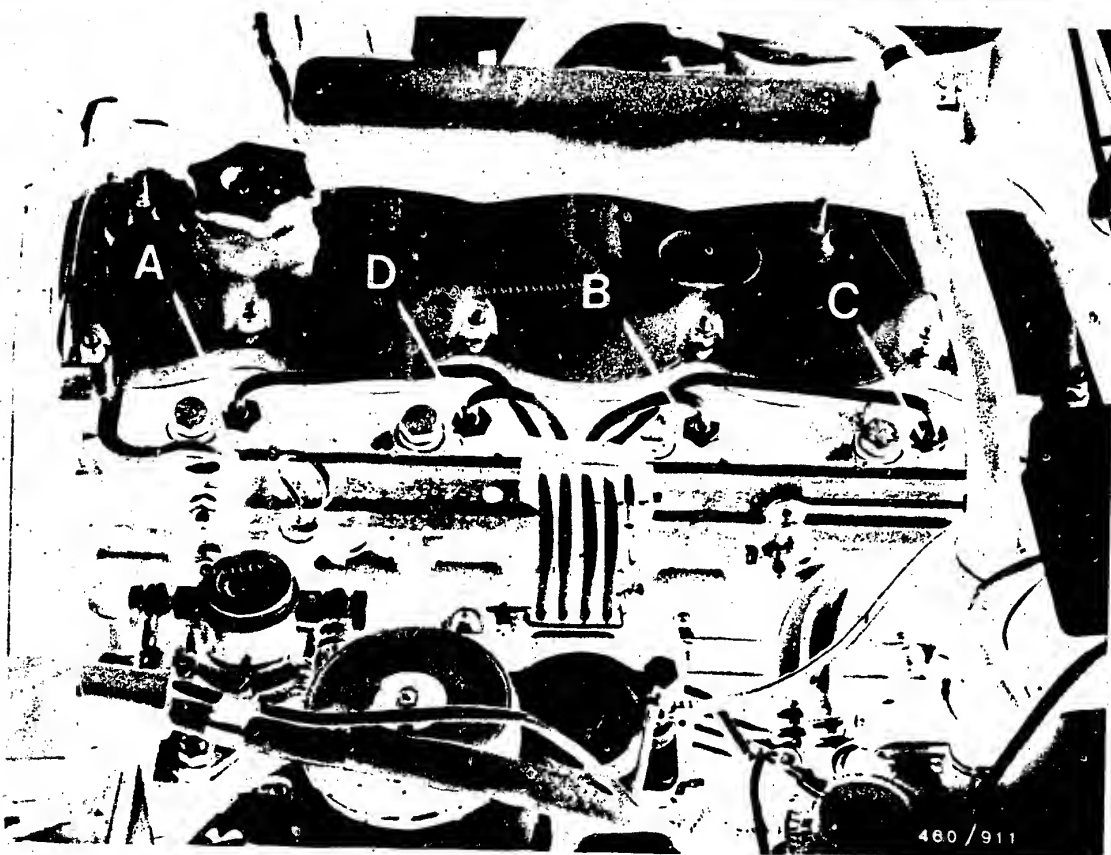
Loosen the bleeder screw on the filter cover (A) a few turns.

Loosen the water drain screw at the base of the filter (A) (not visible in the picture), and drain off the water.

Tighten water-drain plug and bleeder screw and check for leaks.

If necessary, bleed fuel filter.





### 15. Test Injection System for Leaks

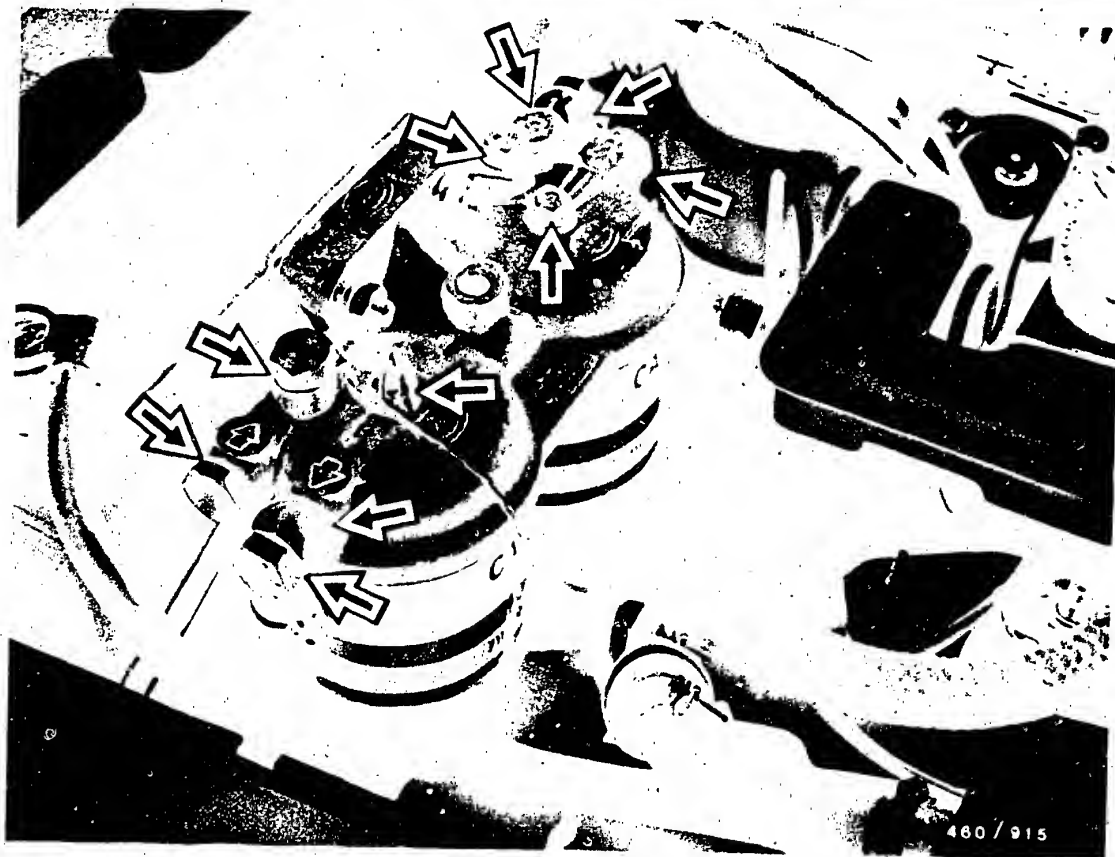
Perform leak test with engine at normal operating temperature.

Examine all connection points of fuel lines.

Pay particular attention to:

- Connections on nozzle-holder assemblies (A...D).



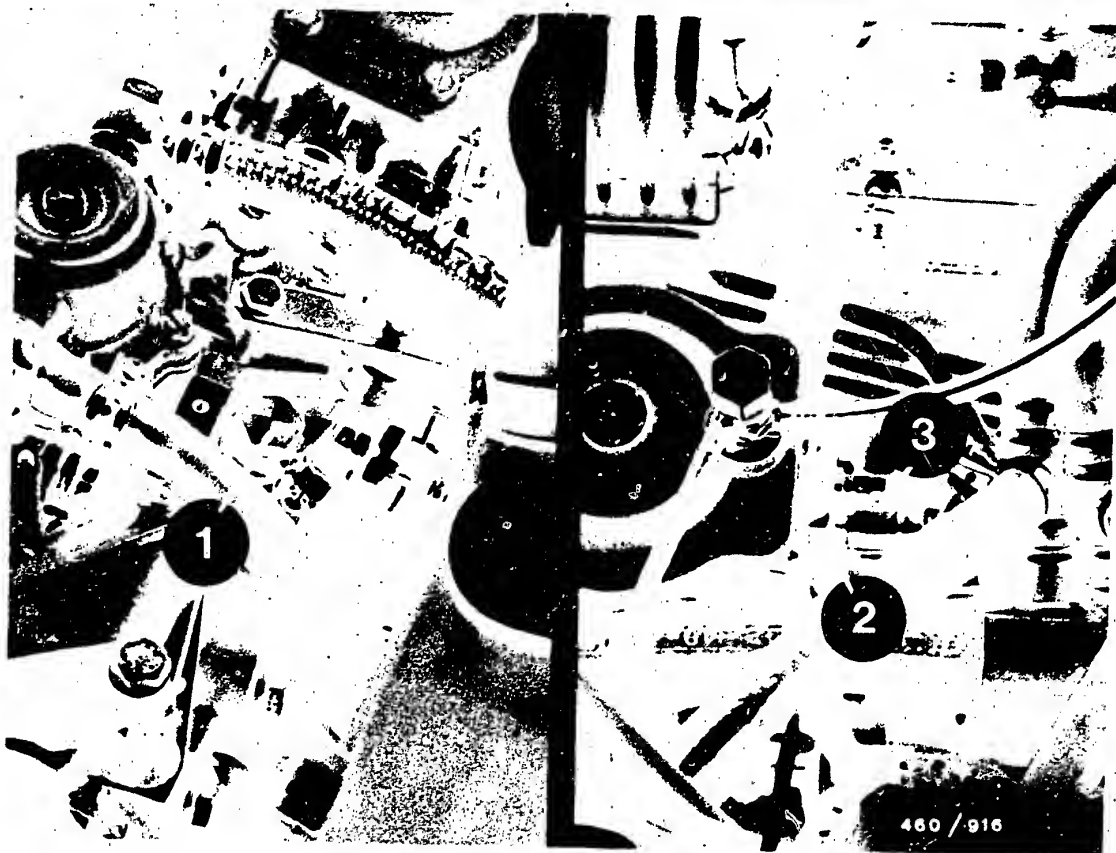


- Screwed connections on the fuel filter (arrows).

**B20**

Check fuel-injection system for leaks  
Fiat Argenta 2500 turbo-Diesel

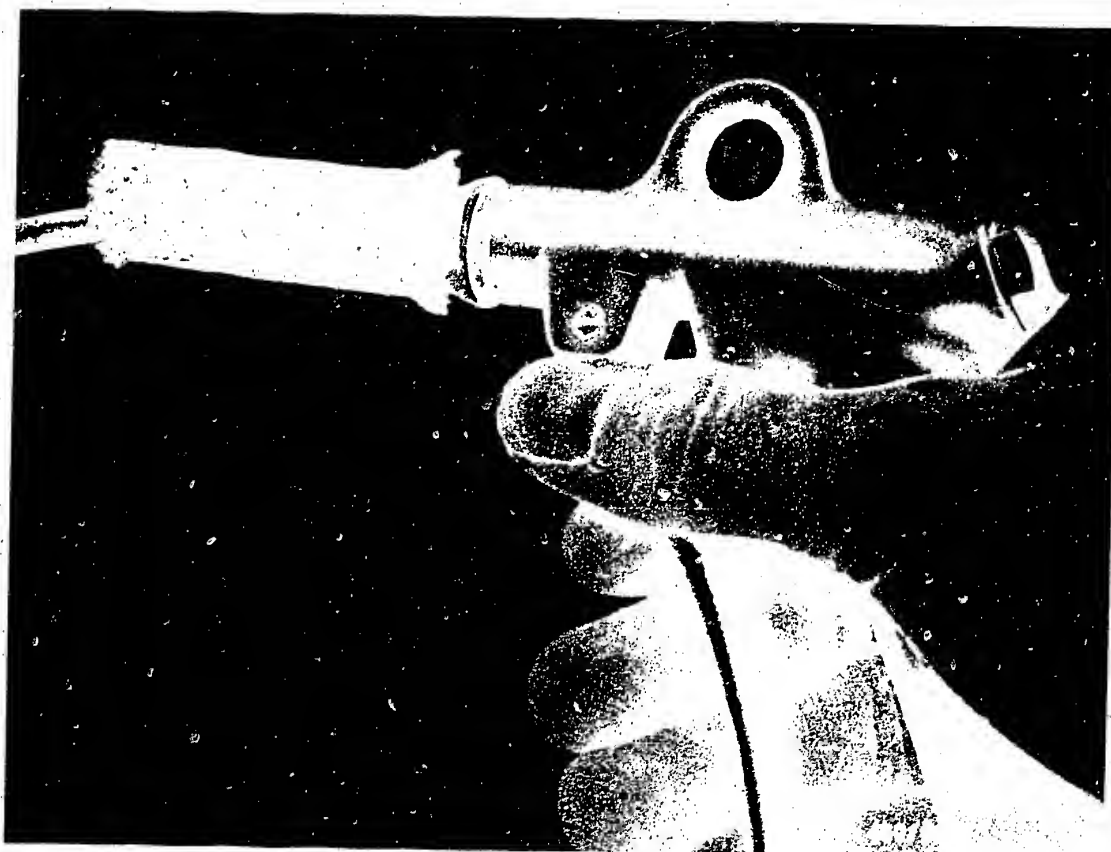




- Inlet line (1) and return line (2) on distributor-type injection pump.
- Delivery-valve holders on hydraulic head (3).

Examine fuel lines for hairline cracks.





#### 16. Check fuel lines

Subject suspect fuel lines to a visual inspection.

If there is no detectable pinching or kinking, the fuel line in question must be removed.

Check fuel line for throughflow using compressed air and clean if necessary.

A suitable hose piece may be used as a side seal for blowing out the fuel lines.



17. Smoke test - check air filter

17.1 Smoke test

Summary of the contents of the legal regulations (as at April 1978). Applicable to Federal Republic of Germany.

This regulation applies only to the homologation of motor vehicles having at least 4 wheels with a maximum permissible speed of more than 25 km/h. A smoke emission test is not prescribed for official general inspections.

Parts which may have an influence on environmental pollution must be designed in such a way that the legal requirements are met during operation and despite vehicle vibration.

This applies in particular to cold-start devices and full-load stops. The Rheinland-Westfälische TÜV (Technical Inspection Bureau of Rhineland-Westfalia) in Essen is the sole approval agency.

**B23**

Smoke test

Fiat Argenta 2500 Turbo-Diesel





### 17.2 Test setup

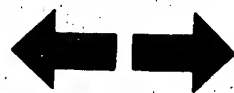
The smoke test is conducted using the Bosch filter-type smokemeter.

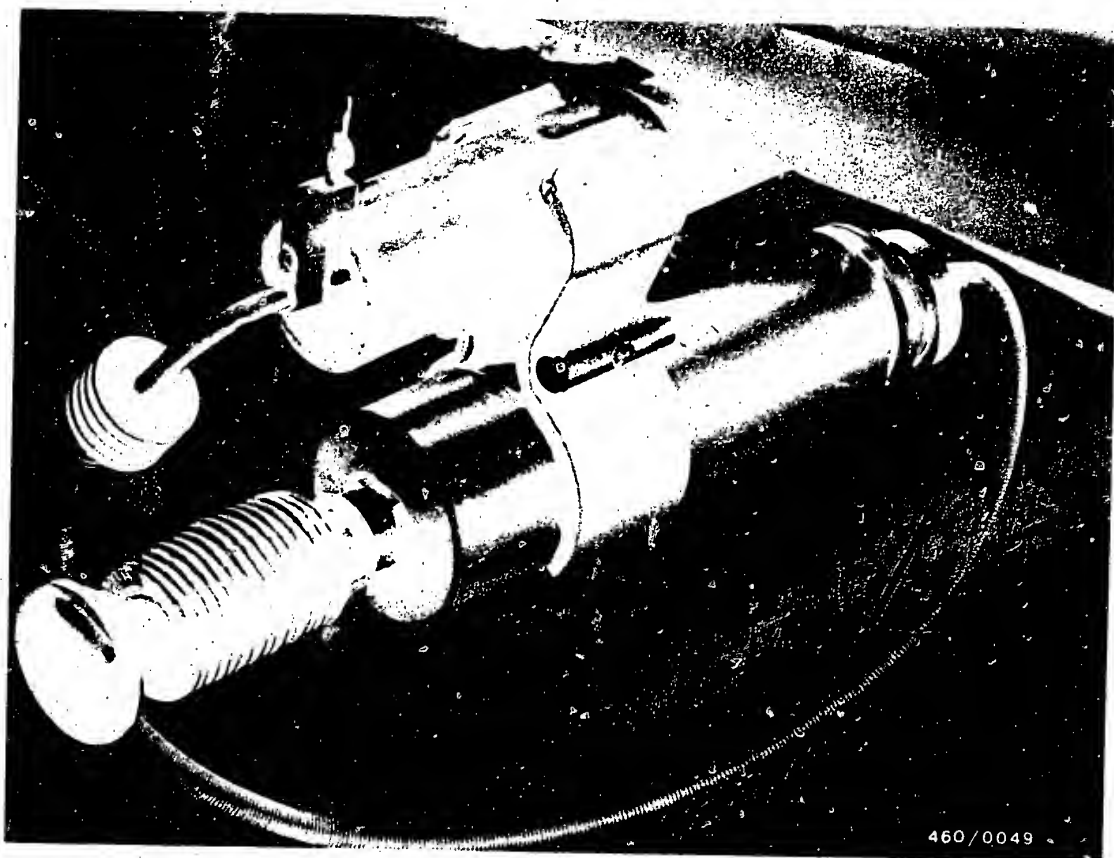
The filter-type smokemeter consists of the following units:

Accessories box with proportioning pump 0 681 169 038

Evaluating unit 0 684 102 050

Insert filter plate into proportioning pump.





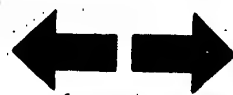
Mount sampling pump on exhaust pipe using appropriate clamp.

Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.

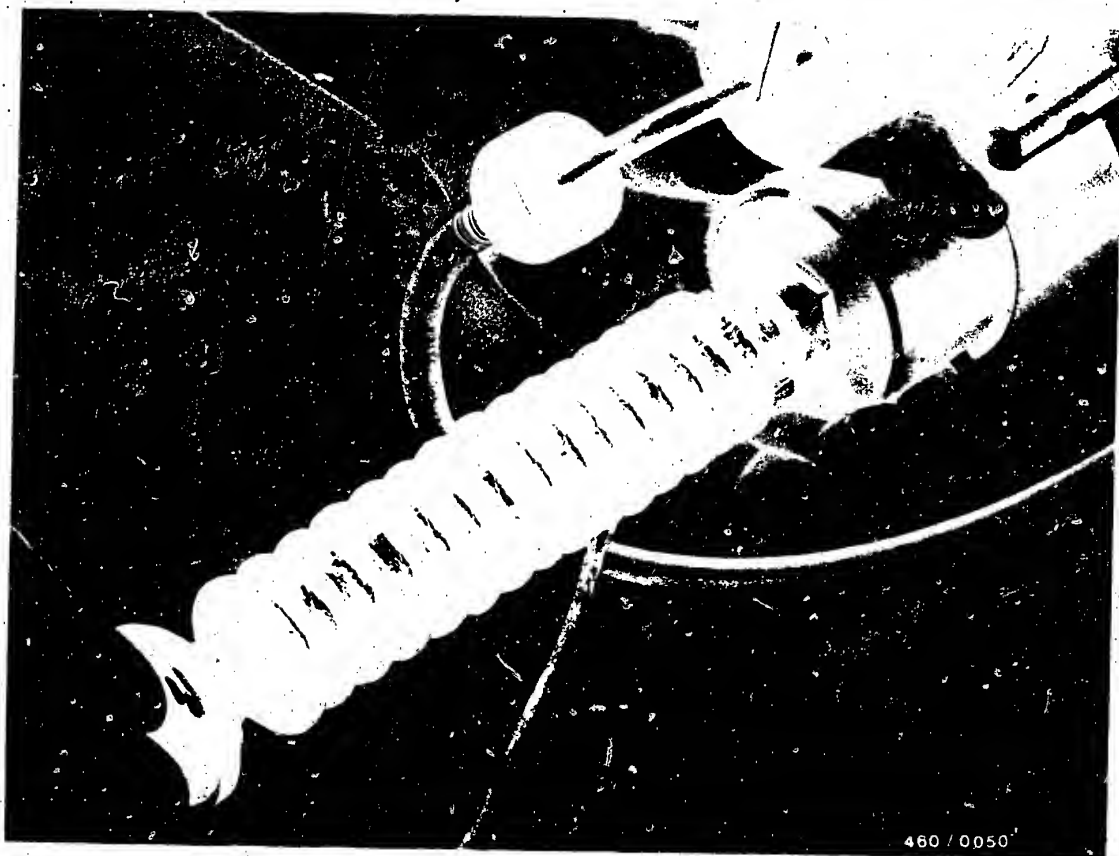
**C1**

Smoke test

Fiat Argenta 2500 Turbo-Diesel







### 17.3 Test procedure

Set proportioning pump by pressing in the black push-button.

Take rubber ball on triggering hose and enter passenger compartment.

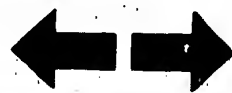
The test can be performed on the chassis dynamometer or on the road (gradient).

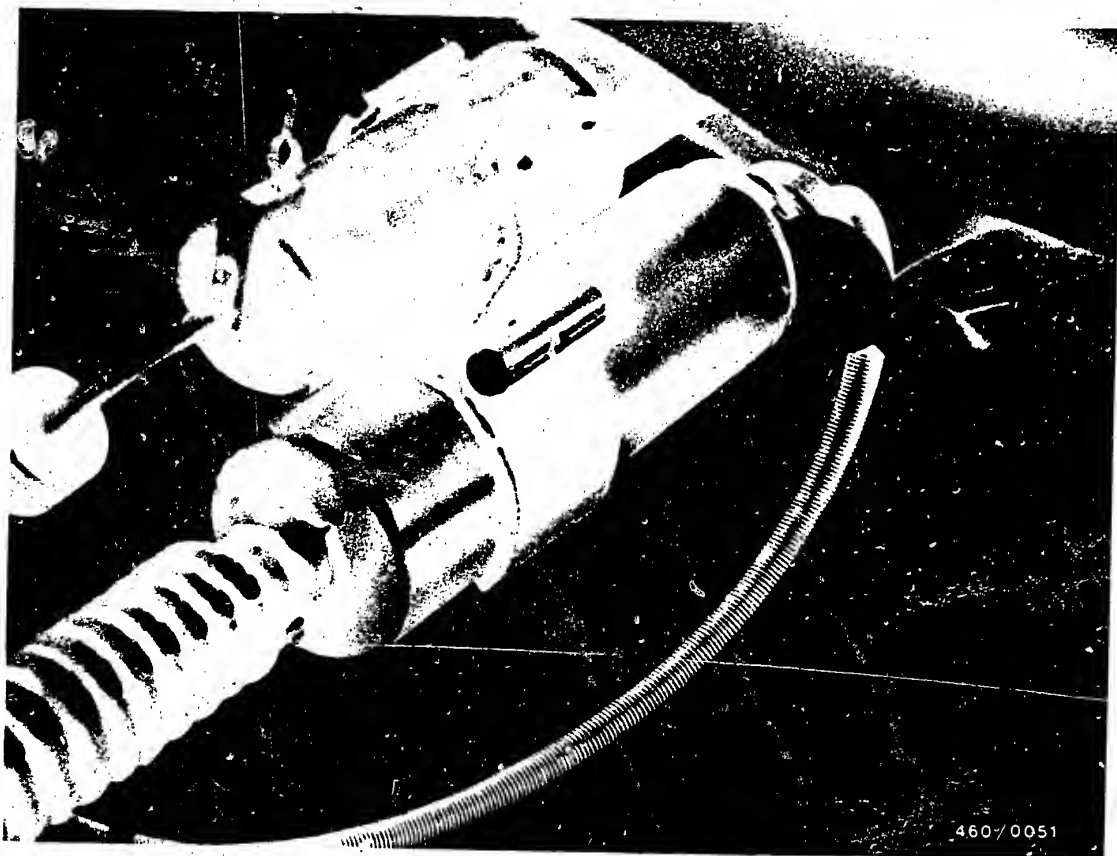
The chassis dynamometer is preferable in any case. Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 40 km/h is reached. Load the engine so that, with the accelerator in the same position, a speed of approx. 25 km/h is reached.

**C2**

Smoke test

Fiat Argenta 2500 Turbo-Diesel





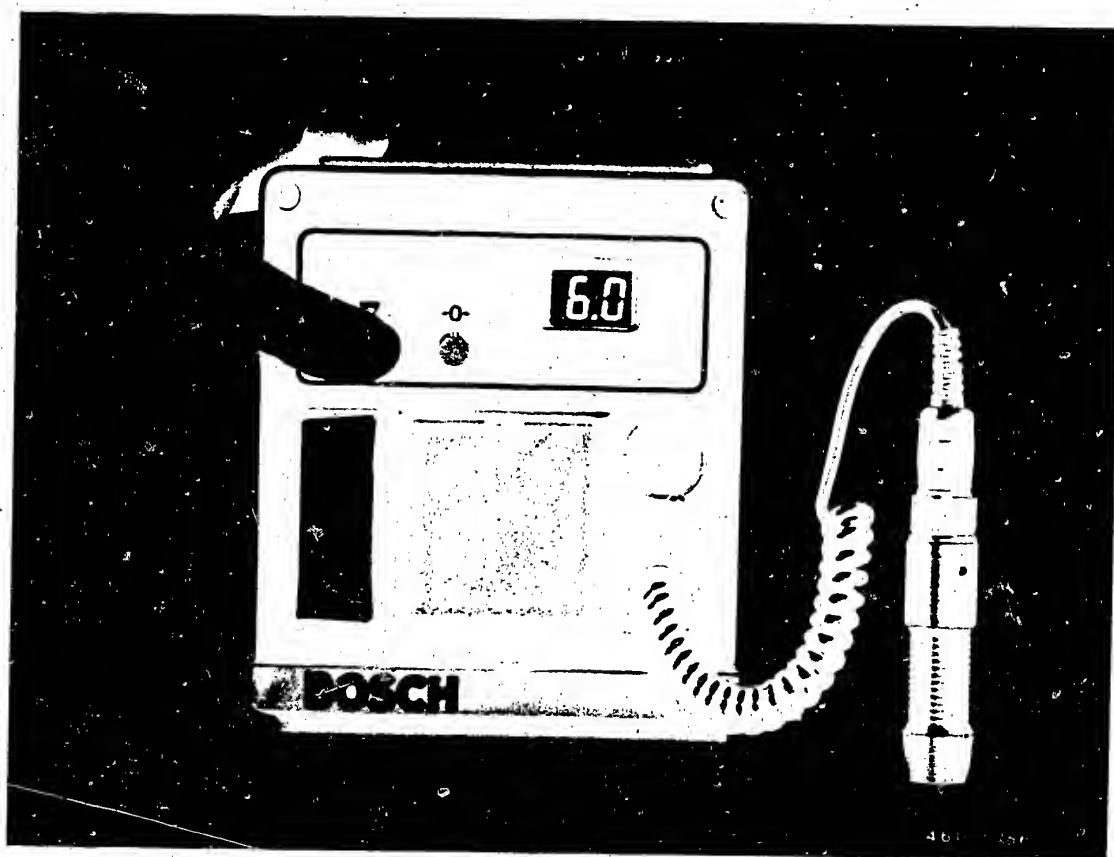
Maintain this load condition for 5 seconds and then trigger the sampling pump by pressing the rubber ball.

Switch off engine.

Caution!

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove filter plate from sampling pump.



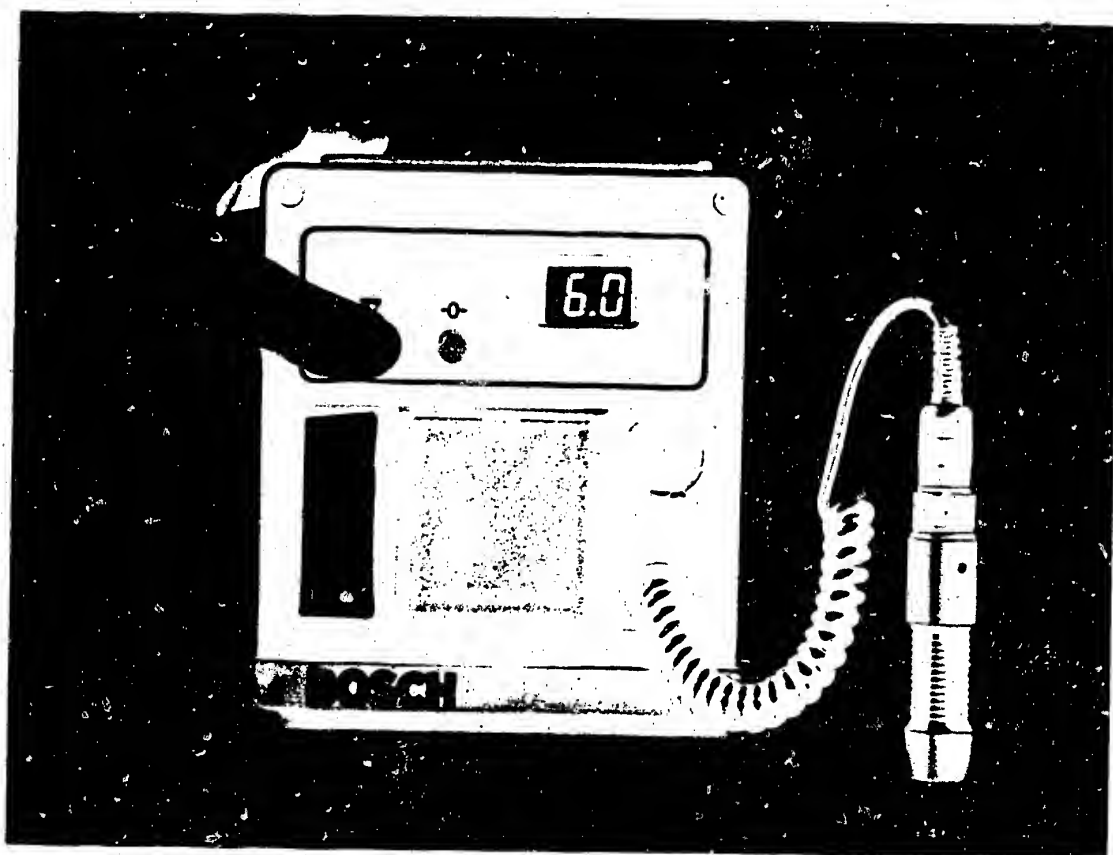
### Setting the Zero Point

The zero point adjustment must be performed

- before each measurement series
- if there are changes in ambient conditions
- each time the lens of the photo-element adapter has been cleaned.

Firmly press the measuring head of the photo-element adapter onto 5 clean, white filter plates placed one on top of the other.

Press button "0" until display 0.0 appears.  
Release button "0".



### Measuring

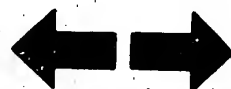
With the sooted side at the top, lay filter plate from metering unit on 3 new filter plates placed one on top of the other.

Press measuring head vertically onto black surface of filter plate.

Simultaneously press button "C" until the measured smoke number appears on the display.

### Note:

Measuring head must be firmly mounted both for the zero point adjustment and for measuring (even slight tilting may lead to incorrect measurements).

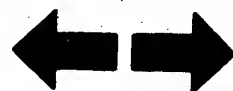


Compare the smoke number with the evaluation sheet.  
Note kW (HP) information of vehicle manufacturer.

**C6**

Smoke Test

Fiat Argenta 2500 Turbo-Diesel



#### 17.4 Check air filter

Remove air filter and subject to a visual examination.

##### Test criteria for air filter:

- Dusty air filter (test by knocking out air filter)
- Oil-fouled air filter
- Solid matter in air filter, e.g. leaves

If in doubt, use a new filter element.





### 18. Adjust idle speed

Connect tachometer (e.g. photoelectric) to engine.

#### Note:

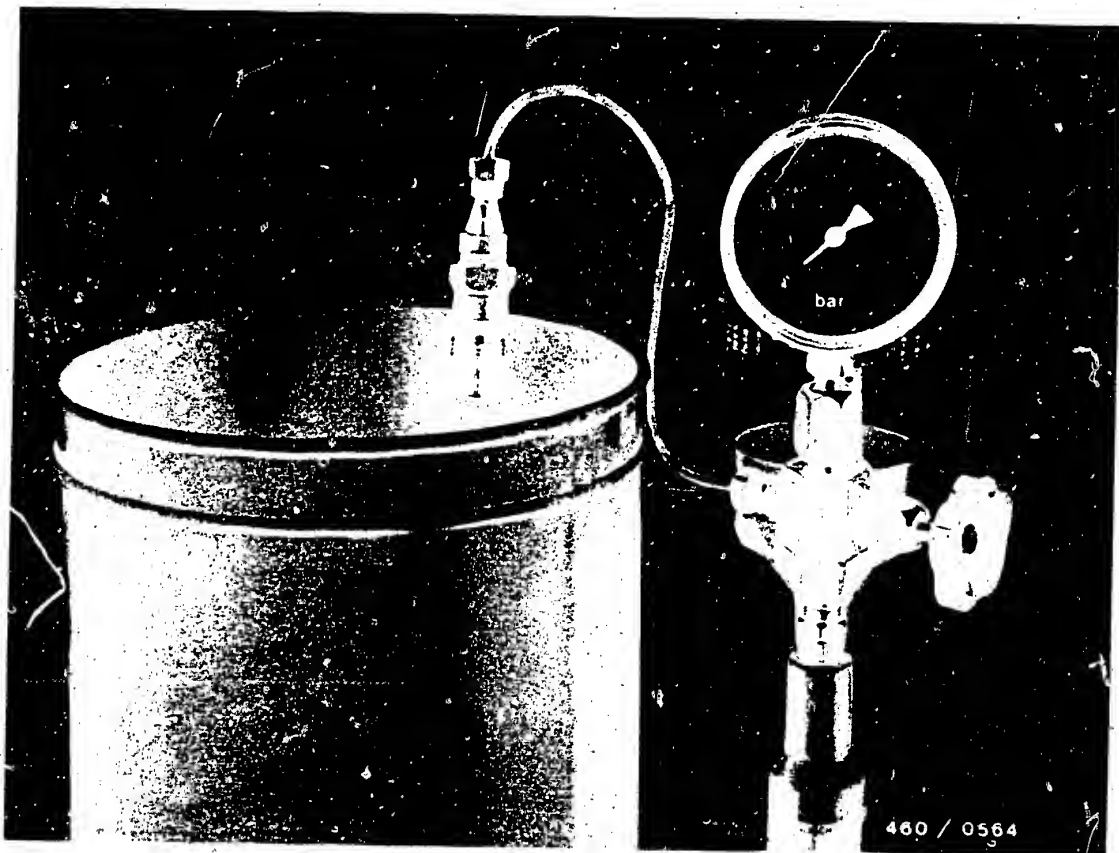
To adjust the idle speed, the engine must be at normal operating temperature, coolant temperature  $+ 80^{\circ}\text{C}$ .

Set the engine speed to  $700 + 30 \text{ min}^{-1}$  at the idle-adjusting screw (arrow).

Note that the camshaft and injection pump are driven at half the engine speed.

After adjusting, lock and seal adjusting screw.





### 19. Test injection nozzles

Remove injection nozzles.

The test is performed using the nozzle tester EFEP 60 H 0 681 200 502.

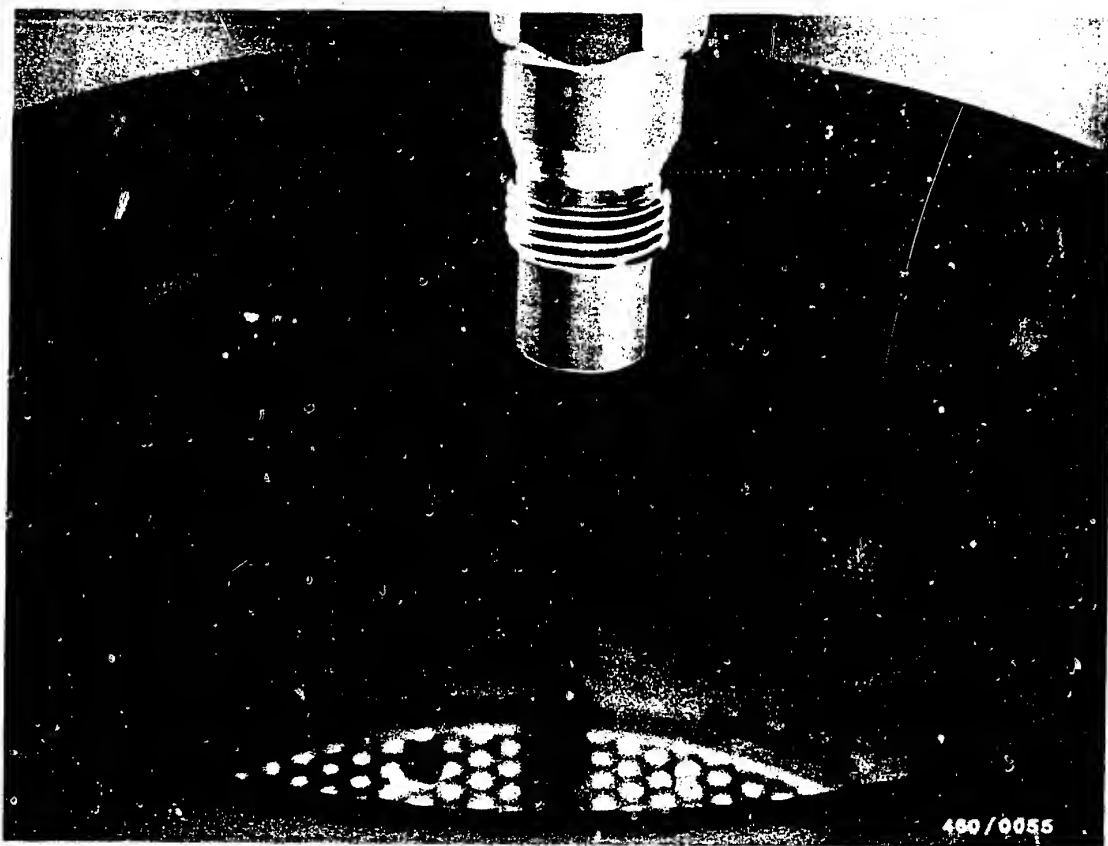
Mount injection nozzle with nozzle-holder assembly on nozzle tester.

#### Caution:

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.







### 19.1 Spray test

Switch off pressure gauge.

The spray pattern cannot be assessed until when the lever is being operated quickly (approx. 4-6 strokes per second). The spray must be quite concentrated and break off cleanly.

### 19.2 Chatter test

The pressure gauge is switched off.

Fully depress the lever of the tester slowly (1-2 strokes per second).

Nozzles in good working order must chatter when fuel escapes.

### 19.3 Check injection pressure

Switch on pressure gauge.

Slowly force lever downwards. When nozzle begins to squirt, read off injection pressure.

In the case of deviations from the nominal value, the nozzle-opening pressure must be adjusted by shims behind the pressure spring in the nozzle-holder assembly.

Nominal value: 170 bar

Thicker shims = higher nozzle-opening pressure

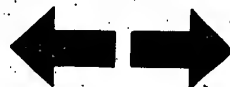
Thinner shims = lower nozzle-opening pressure

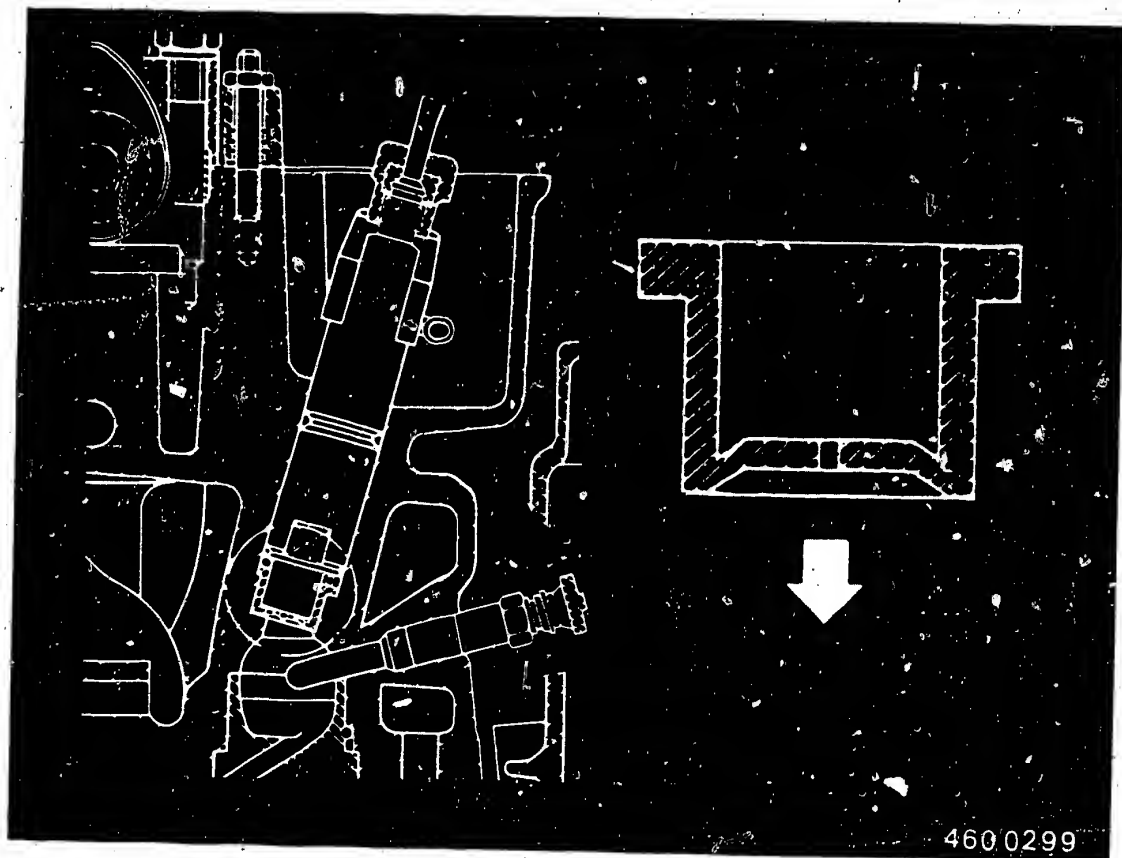
Increasing the spring travel by 0.05 mm causes a 5.0 bar increase in the nozzle-opening pressure.

### 19.4 Leak test

Pressure gauge on.

Slowly press lever downward and maintain pressure approx. 20 bar below the opening pressure for 10 seconds. No drop may fall from the nozzle.





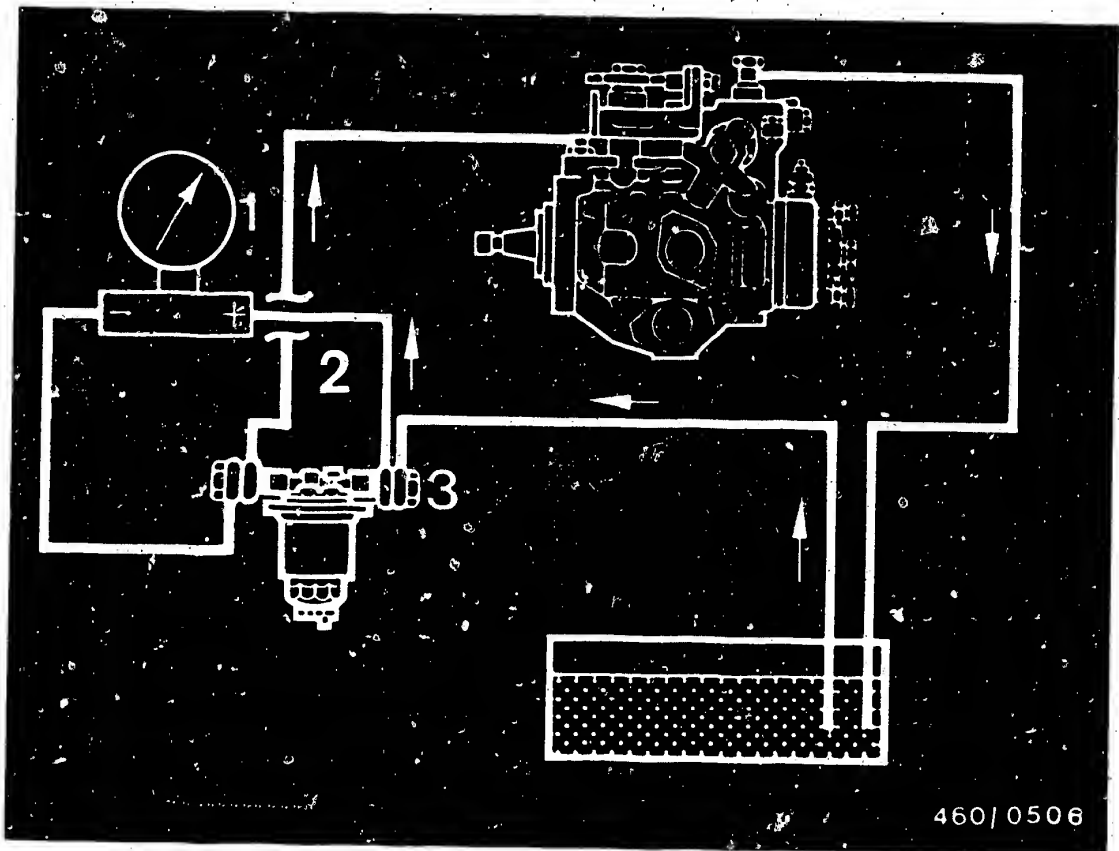
### 19.5 Install injection nozzles

Before installing the injection nozzles, fit a new heat seal in the direction of the arrow with respect to the cylinder head (Picture).

Tighten the fastening screws of the nozzle-holder assembly to 49 Nm (4.9 kgfm).

Tighten the union nuts of the fuel-injection tubing to 25 Nm (2.5 kgfm).





- 1 = Differential-pressure gauge
- 2 = Filter outlet (use inlet union and extra-long inlet-union screw 2 443 456 020).
- 3 = Filter inlet (use inlet union and extra-long inlet-union screw 2 443 456 020).

## 20. Check fuel filter

Connect differential-pressure gauge to fuel filter using appropriate connecting pieces.





Connect the (+) side of the differential-pressure gauge to the fuel filter inlet. Fit the (-) connection of the pressure gauge to the filter outlet. See connection diagram.

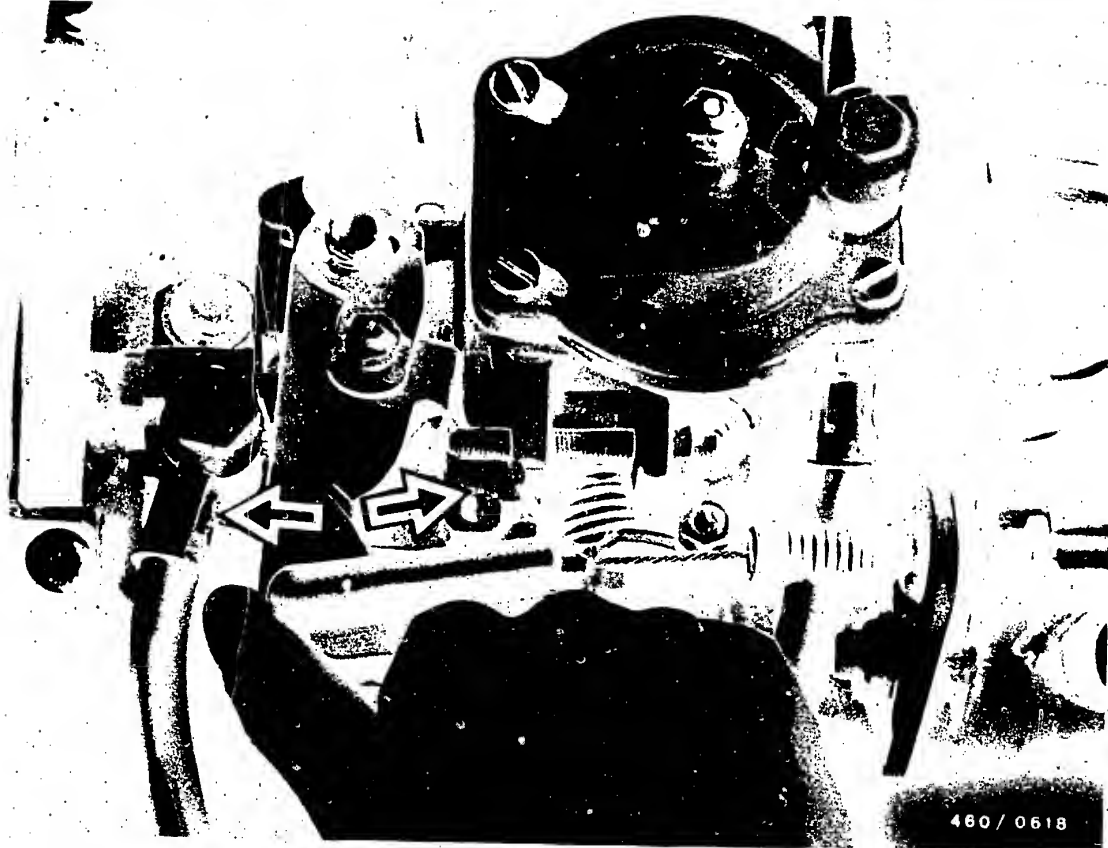
Run engine until you are sure that there is no air in the fuel system.

**C14**

Check fuel filter

Fiat Argenta 2500 Turbo-Diesel





Move injection-pump control lever briskly (approx 1 second) from the idle stop to the maximum-speed stop.

Release control lever and read off differential pressure on pressure gauge.

The differential pressure may be max. 0.3 bar.  
If this value is exceeded, replace filter. Remove test connections.

If necessary, bleed fuel system.



## 21. Check pre-heating system

### 21.1 Necessary test equipment

Voltmeter/ammeter e.g. ETI 011.00 0 684 101 100

### 21.2 Workshop information

We recommend that the "R"-type sheathed-element glow plugs be replaced every 45 000 km.

### 21.3 Pre-heating times

The pre-heating time is dependent on the ambient temperature.



### Test preheating system

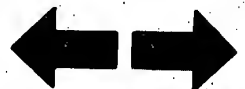
The preheating system is in operation during starting. If, after the indicator lamp goes out, the starting motor is not actuated, the preheating system switches off automatically after approx. 10 - 15 seconds.

#### Note:

If a glow plug or the power-supply lead has a short circuit to ground, the power supply to the glow plugs will be cut by the glow-duration unit.

#### Caution!

Never connect test lamp in parallel between terminal 6 of glow-duration unit and a ground point since this will lead to the destruction of the glow-duration unit.





## Test preheating system

All engines are equipped with a rapid preheating system.

- Test condition:  
Battery o.k.?

### Test power supply

- Connect test lamp in parallel between glow plugs and ground
- Turn glow-plug and starter switch to "MAR" position.
- Test lamp and glow-plug indicator lit?

Yes

Continued on C20/C21

### Check ground terminal on glow-duration unit

- Connect voltmeter (e.g. VA tester ETT 011.00) between terminals 1 and 2 on glow-duration unit.
- Battery voltage present?

No

Yes

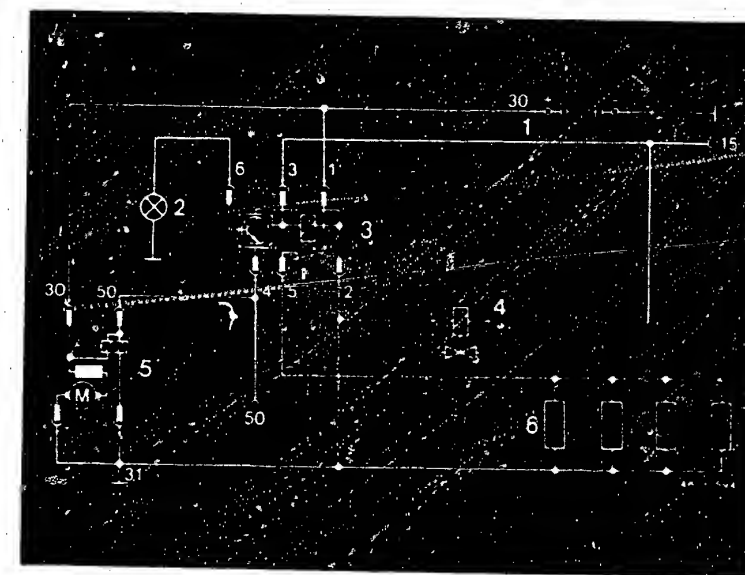
### Check power supply to glow-duration unit

- Connect voltmeter between terminals 2 and 3 on glow-duration unit.
  - Turn glow-plug and starter switch to "MAR" position.
- Battery voltage present?

No

Yes

Continued on C20/C21



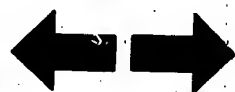
Test ground terminal (lead, black) on glow-duration unit.

Test connecting lead (blue-white) from glow-plug and starter switch to glow-duration unit and corresponding contacts for open circuit.

**C18**

Check preheating system

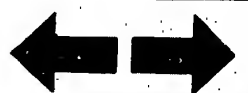
Fiat argenta 2500 Turbo-Diesel



**C19**

Check preheating system

Fiat Argenta 2500 Turbo-Diesel



## Test preheating system (continued)

Yes

### Test preheating time and on-time.

Turn back glow-plug and starter switch and return to drive position. Measure preheating time. When glow-plug indicator lamp goes out test lamp must remain lit for a further approx. 10 - 15 seconds. Preheating time should conform to the following table.

Engine compartment temperature	Preheating time
at - 20°C	approx 21 ... 27 sec
at + 20°C	approx 4.5 ... 7 sec
at + 50°C	approx 1.5 ... 4.5 sec

No

Repeat test with new glow-duration unit

Yes

Continued on C22/C23

Yes

### Check power supply to glow-duration unit when starting.

- Connect voltmeter between terminals 2 and 4 on glow-duration unit.
- Turn glow-plug and starter switch to position "AVV".

Battery voltage present?

No

Check connecting lead (red) from starting motor Term. 50 to the glow-duration unit for a break.

Yes

### Check power supply to glow-plug indicator lamp

- Connect voltmeter between terminals 6 and 2 on glow-duration unit.
- Turn glow-plug and starter switch to position "MAR".

Battery voltage present?

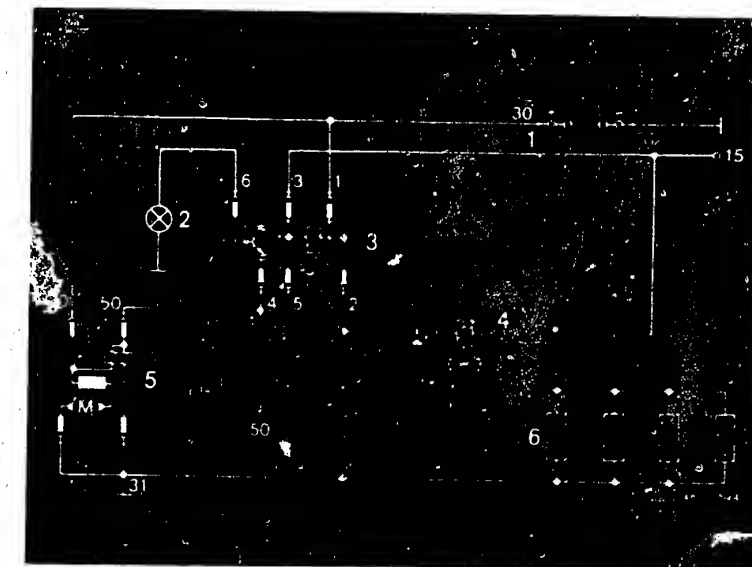
No

Check leads and connections to the glow-plug indicator light and corresponding contacts on the glow-duration unit for a break. Is there battery voltage present?

No

Glow-duration unit defective, replace.

Yes



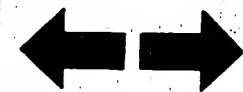
**C20**

Check pre-heating system  
Fiat Argenta 2500 Turbo-Diesel



**C21**

Check pre-heating system  
Fiat Argenta 2500 Turbo-Diesel



## Test preheating system (continued)

Yes

### Check glow-plugs

If there is difficulty starting, check whether all glow-plugs are working properly.

Test voltage at glow-plugs with test lamp:

- Remove lead and bus bar for glow-plugs.
- Connect test lamp to battery + and, one after the other, to each glow-plug.
- Lamp lit = glow-plug o.k.?
- Lamp not lit, glow-plug defective, replace (tightening torque 15 Nm). If glow-plugs burned out, see Note on right.

Test power supply to glow-plugs with VA tester ETT 011.00:

- Connect ammeter (e.g. ETT 011.00) into lead to glow-plugs.
- Turn glow-plug and starter switch to "preheating".
- Make reading of current.  
Set value: approx. 50 A  
Set value reached?

No

Yes

Glow-plugs o.k. (Fault is in fuel supply).

### Note:

Current consumption after stabilisation approx. 12 A per glow-plug. If current consumption of glow-plug is approx.

36 A = one glow-plug defective  
24 A = two glow-plugs defective  
12 A = three glow-plugs defective

These current readings are only obtained with a battery voltage of above 120 V.

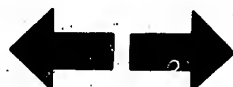


Installation position of glow-duration unit (arrow)

**C22**

Check pre-heating system

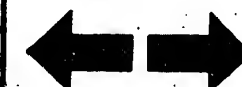
Fiat Argenta 2500 Turbo-Diesel

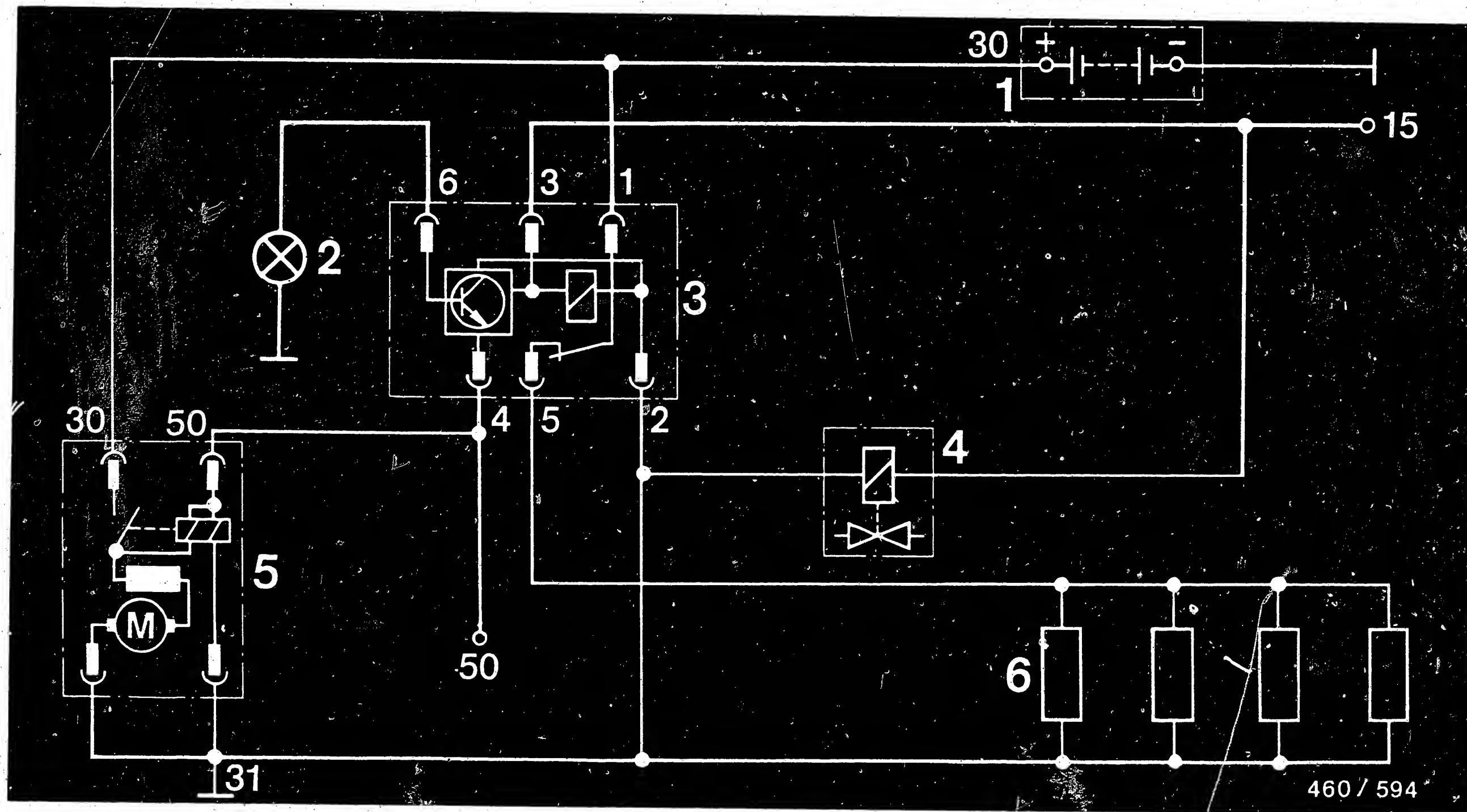


**C23**

Check pre-heating system

Fiat Argenta 2500 Turbo-Diesel





1 = Battery  
2 = Preheating indicator lamp

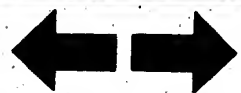
3 = Glow-duration unit  
4 = Solenoid-operated valve

5 = Starting motor  
6 = Glow plugs

21.4 Terminal diagram for preheating system

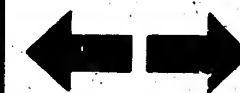
**D1**

Test pre-heating system  
Fiat Argenta 2500 Turbo-Diesel

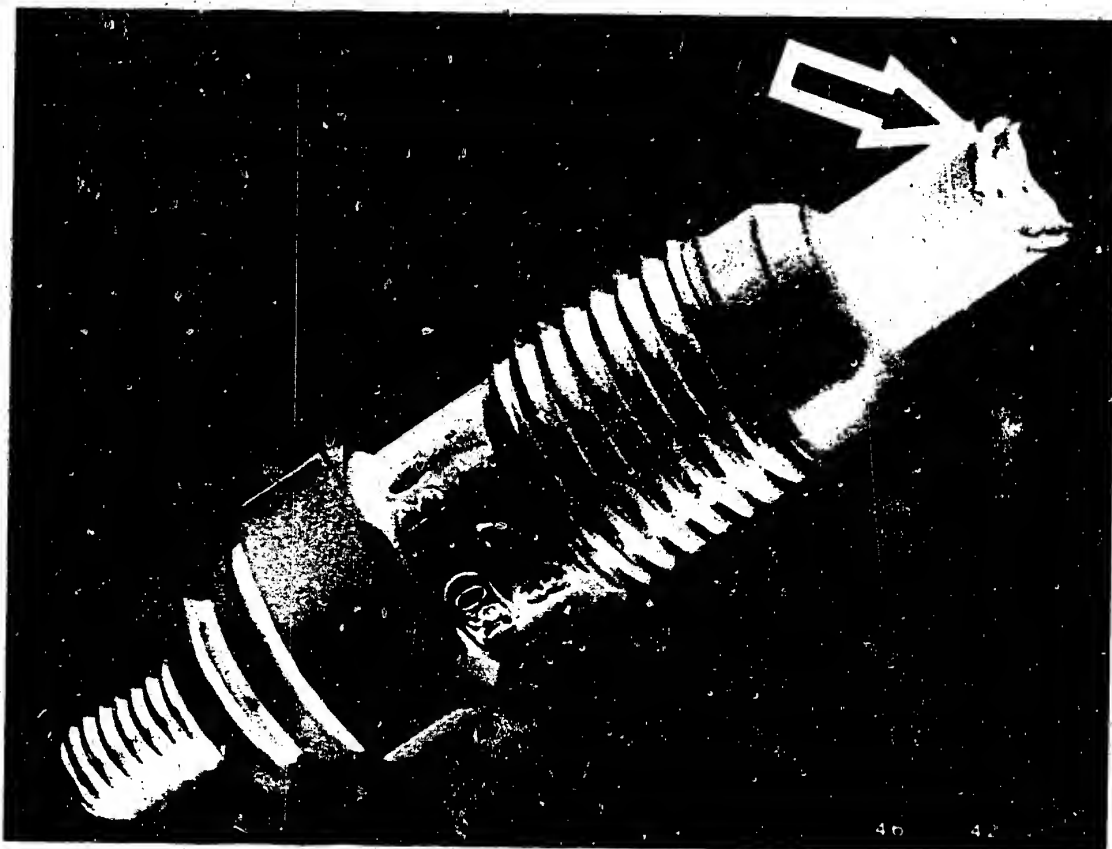


**D2**

Test pre-heating system  
Fiat Argenta 2500 Turbo-Diesel



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Note:

Glow plugs with burned elements

Glow plugs with burned elements are frequently the result of troubles with the injection nozzle.

If glow plugs are found to have burned elements (arrow), it is not sufficient simply to replace them. The injection nozzles must also be tested for spray pattern, chattering, pressure and leaks.

**D3**

Check pre-heating system

Fiat Argenta 2500 Turbo-Diesel



## 22. Check timing device

In distributor-type fuel-injection pumps VE..F.. the timing device is integral with the fuel-injection pump.

In order to test the timing device, it is necessary to remove the fuel-injection pump.

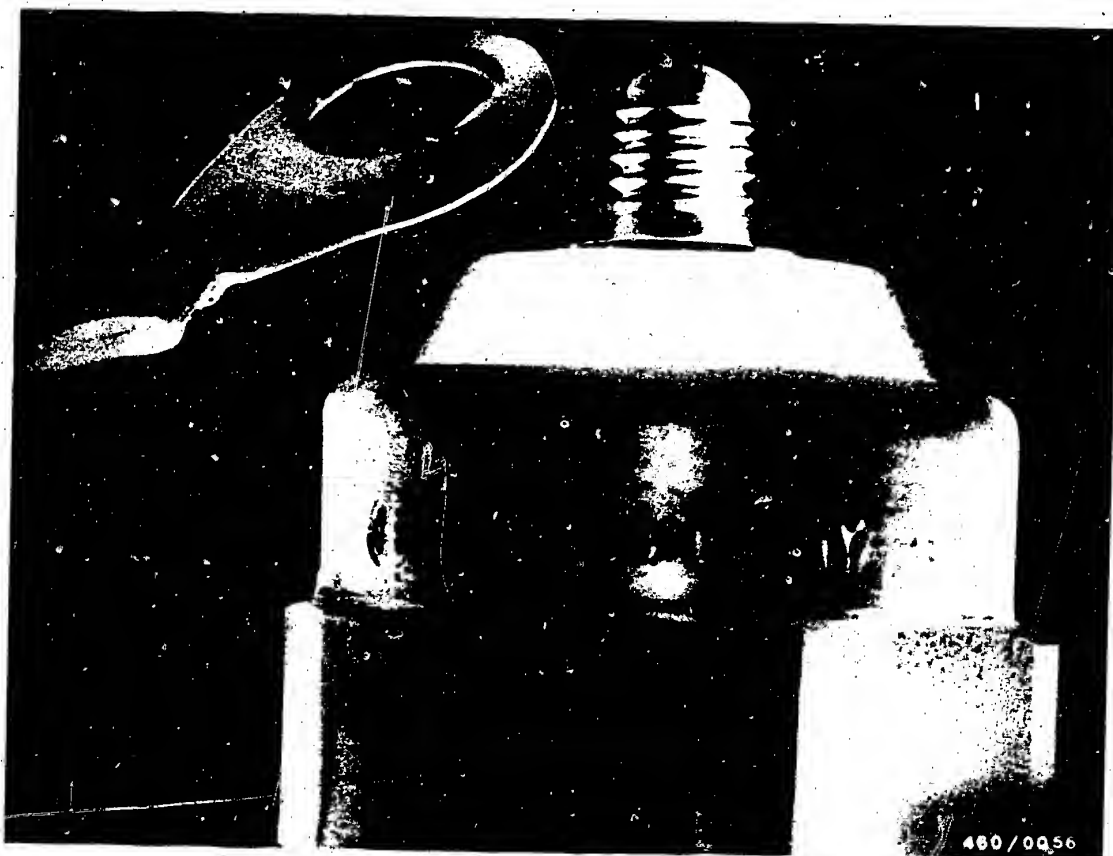
Perform the test on the injection-pump test bench.

**D4**

Check timing device

Fiat Argenta 2500 Turbo-Diesel





## 23. Measure engine compression and compression loss

### 23.1 Measure engine compression

Fit new chart in compression tracer. Mount high-pressure hose on tracer. Switch off engine.

In order to prevent fuel from being injected, remove connecting cable from shutoff magnet on distributor-type fuel-injection pump (picture).



Screw out the nozzle-holder assembly and use suitable connection fittings for the compression pressure tester.

Using the starting motor, turn over the engine several times so that loose deposits are removed from the compression space.

Screw in connecting nipple.

Fit high-pressure hose of compression tester onto connecting nipple.

During the following operation, note first compression stroke in particular.

Operate starting motor until there is no longer any detectable rise in pressure on the compression tracer.

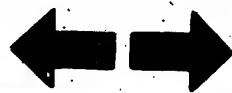
Bleed compression tracer by pressing on bleeder valve.

The pointer returns to the starting position.

Move chart onto next position.

Fit connection nipple to the other cylinders and repeat measurement.

Compression pressure: 22 bar





## 23.2 Evaluation of chart

### 1. Normal pressure rise

If piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase.

During the following compression strokes the compression builds up to the maximum pressure.

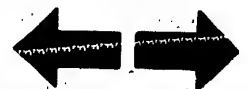
### 2. Gradual pressure rise

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

### 3. Low maximum pressure

If the maximum pressure obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.

If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder head gasket.



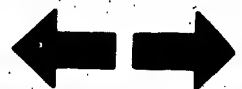
#### 4. Varying compression

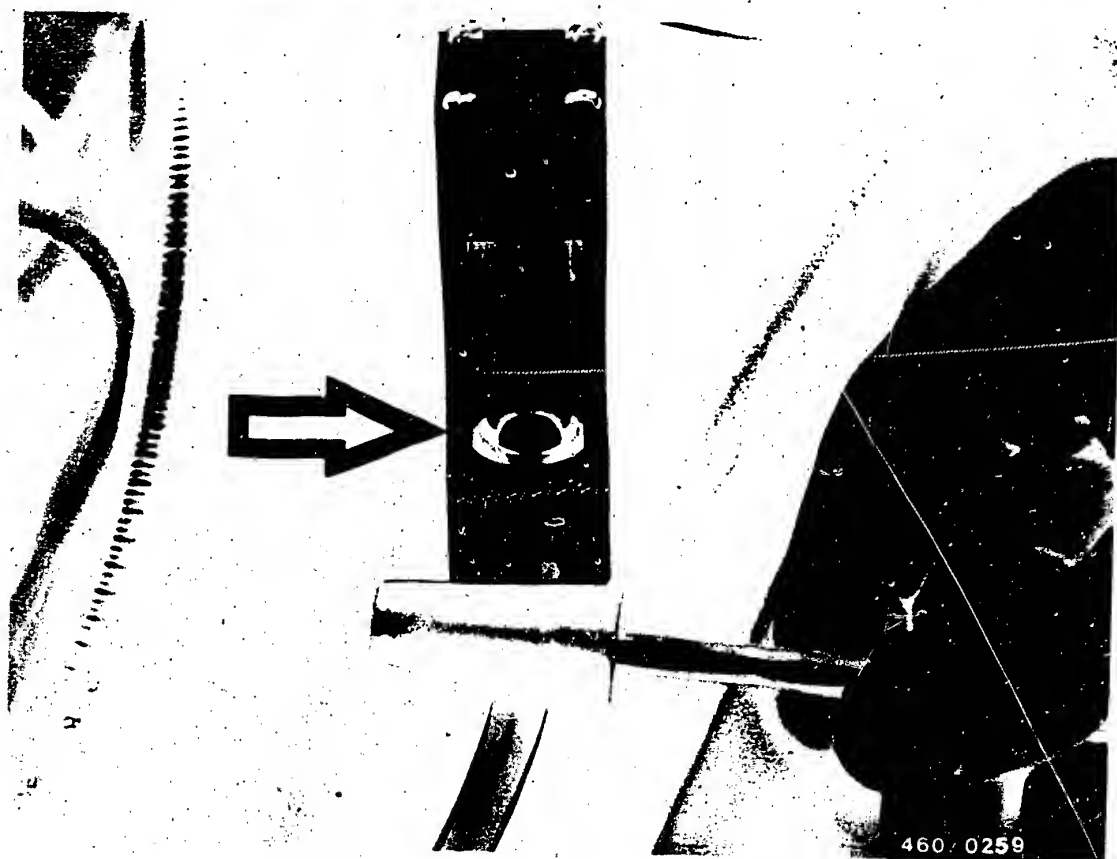
If one cylinder shows a clearly lower compression, proceed as follows: fill in 2-3 cm<sup>3</sup> of engine oil through the opening of the sheathed-element glow plug or nozzle-holder assembly and operate starting motor briefly.

Repeat measurements and compare charts. If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn. If there is no change in the result, then defective valves are the cause.

#### 5. Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine. Maximum compression is, therefore, not the only objective.





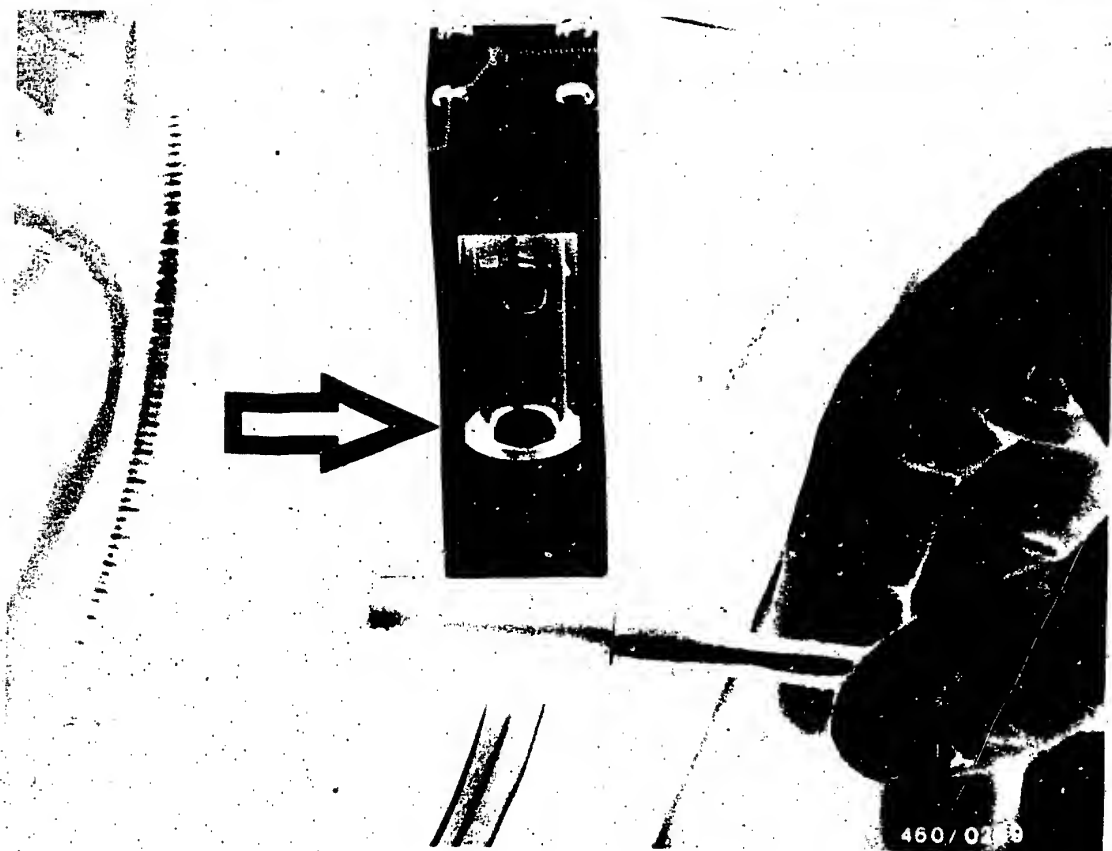
### 23.3 Measure compression loss of engine

The test is performed using the Bosch compression-loss tester 0 681 001 901 (EFAW 210-A).

For testing, the respective piston must be at TDC (TDC = top dead centre) on the compression stroke.

For setting this position, use DC detector 1 688 132 025 (included in accessories with compression-loss tester).

Perform test with engine at normal operating temperature (temperature of water approx. 80 °C).



#### 23.4 Set top dead centre

Remove sheathed-element glow plug from cylinder 1.

Insert rubber plug of DC detector into bore for sheathed-element glow plug.

Using magnetic clamp, mount glass cylinder in as vertical a position as possible in the engine compartment. The piston of the unit must be easily visible.

Slowly turn over crankshaft by hand in engine direction of rotation.

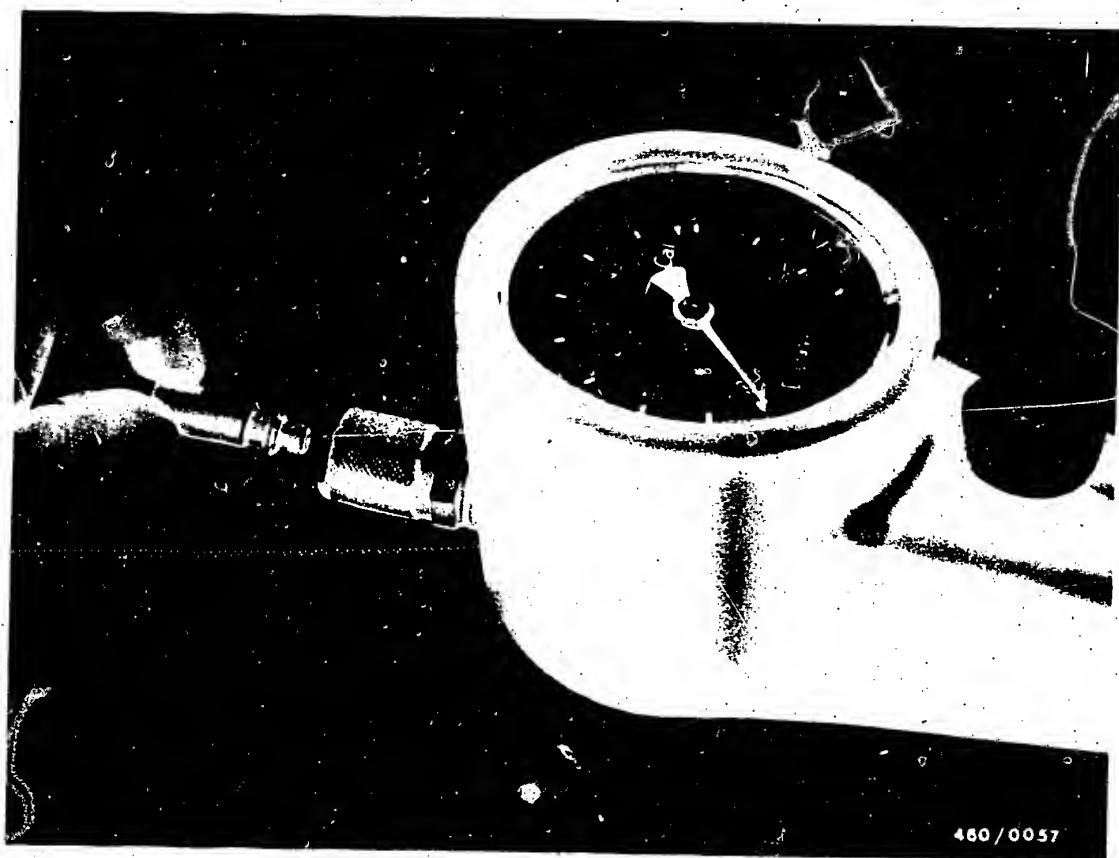
(If necessary, select gear and push vehicle.)



On the compression stroke, the piston of the DC detector is forced upwards.

As top dead centre is passed over, the piston slides down again immediately.

Find top dead centre by carefully turning the crankshaft backwards and forwards.



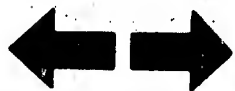
### 23.5 Measure compression loss

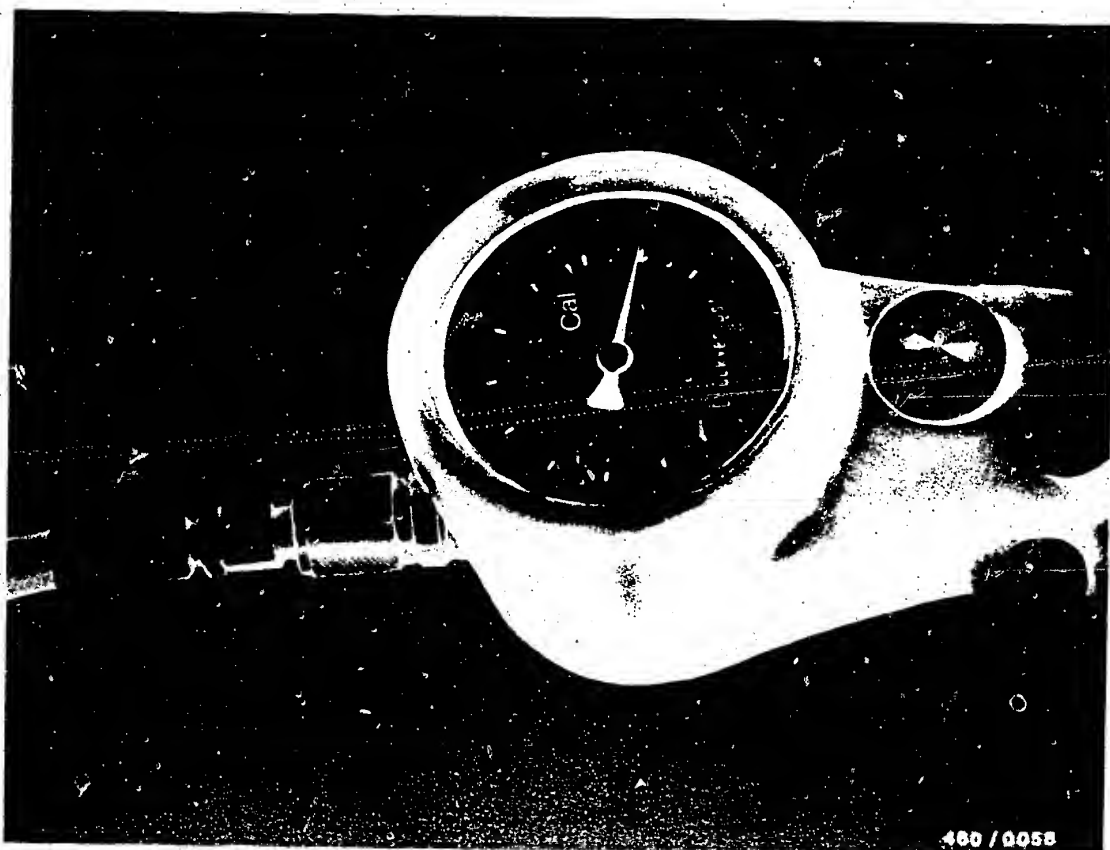
Connect tester to compressed-air mains.

Connect calibrating nozzle 1 680 363 036. Set a compression loss of  $23 \pm 1\%$  (marking "Cal".) at the knurled thumbscrew on the pressure-regulating valve.

Disconnect the calibrating nozzle.

(Instrument indicator must show approximately 0% compression loss - equipment check).





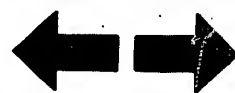
Screw in fitting and mount test hose.  
Select gear and pull on handbrake.  
Connect test hose to tester.  
Read off compression loss in % on instrument.

Note:

Before testing the next cylinder, turn the engine over briefly without pre-heating using the starting motor so that the oil film re-forms.

**D13**

Measure engine comp. and comp. loss  
Fiat Argenta 2500 Turbo-Diesel



### 23.6 Evaluation of test

The compression loss indicated should not exceed 25%.

Differences of 10% between the individual cylinders can be ignored.

The causes of greater losses can be located because the air makes a noise as it escapes.

Listen at the following points:

<u>Location of noise</u>	<u>Possible trouble</u>
Intake manifold (remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filler neck on engine	Pistons, piston rings
Cooling water filler neck (air bubbles)	Cylinder head gasket

In order to trace the trouble even more accurately, fill approximately 2-3 cm<sup>3</sup> of engine oil into the cylinder. Repeat test.

If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5,000 km) may show higher compression losses than after the running-in period.







#### 24. Remove fuel-injection pump

Disconnect negative lead from the battery.

Turn the crankshaft in the direction of engine rotation, until the TDC-mark on the clutch housing aligns with the reference "PMS-1" on the flywheel.

**D15**

Remove fuel-injection pump

Fiat Argenta 2500 Turbo-Diesel





The mark on the camshaft gear and the reference mark on the cylinder head cover (arrow) must align.

Take off the cylinder head cover.

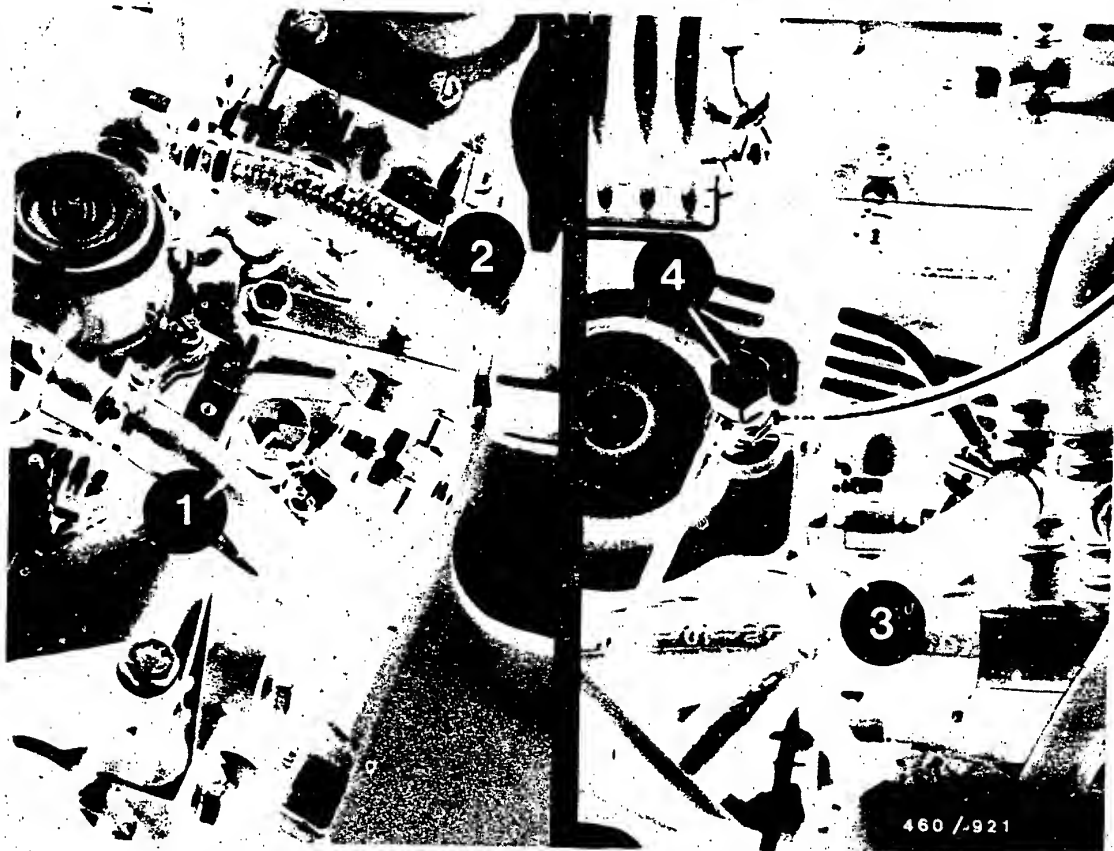
1. Cylinder 1 on compression stroke (valves of cylinder 4 on overlap).

**D 16**

Remove fuel-injection pump

Fiat Argenta 2500 turbo-Diesel



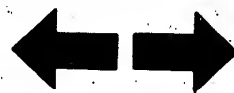


Remove the fuel inlet line (1), the cable on the control lever (2), the fuel return line (3), and the pressure line (4) to the manifold-pressure compensator casing.

Disconnect the lead for the electrical shutoff device (not visible in the picture).

**D17**

Remove fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel



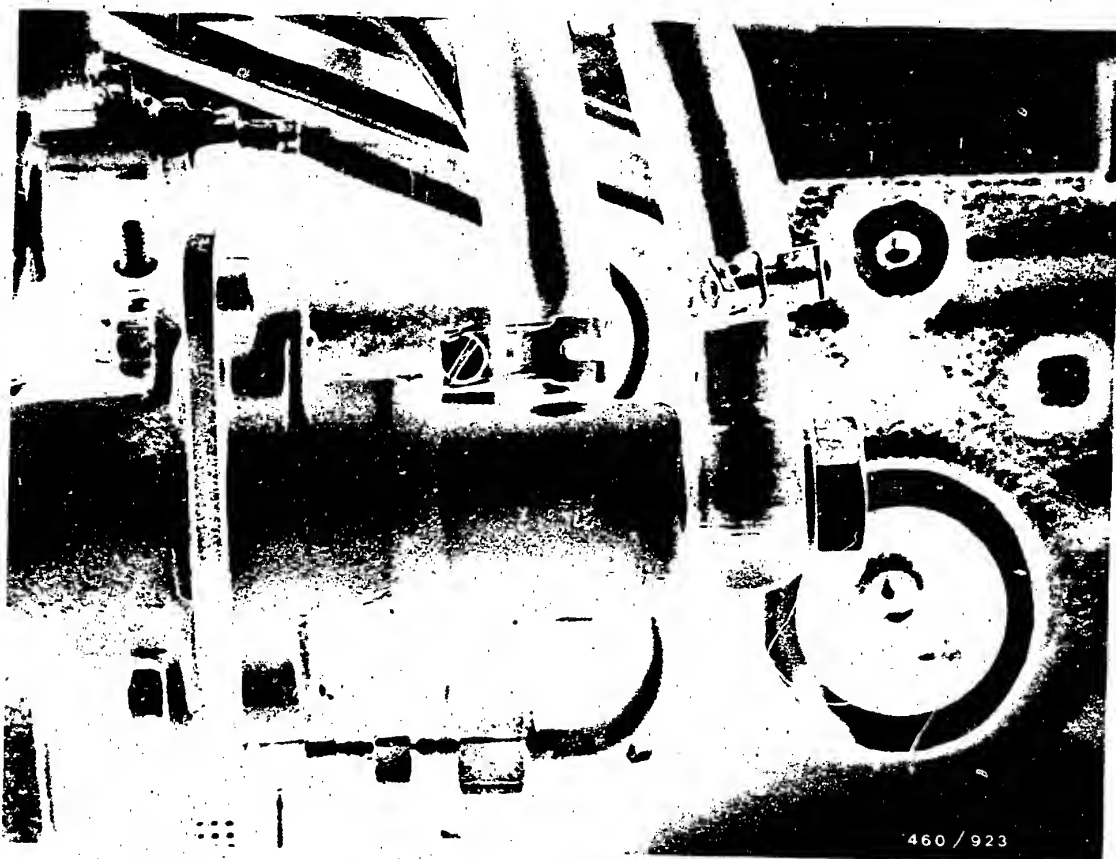


Take out the crankcase vent (arrow).

**D18**

Remove fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel





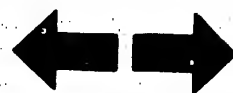
Using commercially available hose clampers, pinch off cooling-water hoses just after injection-pump control device.

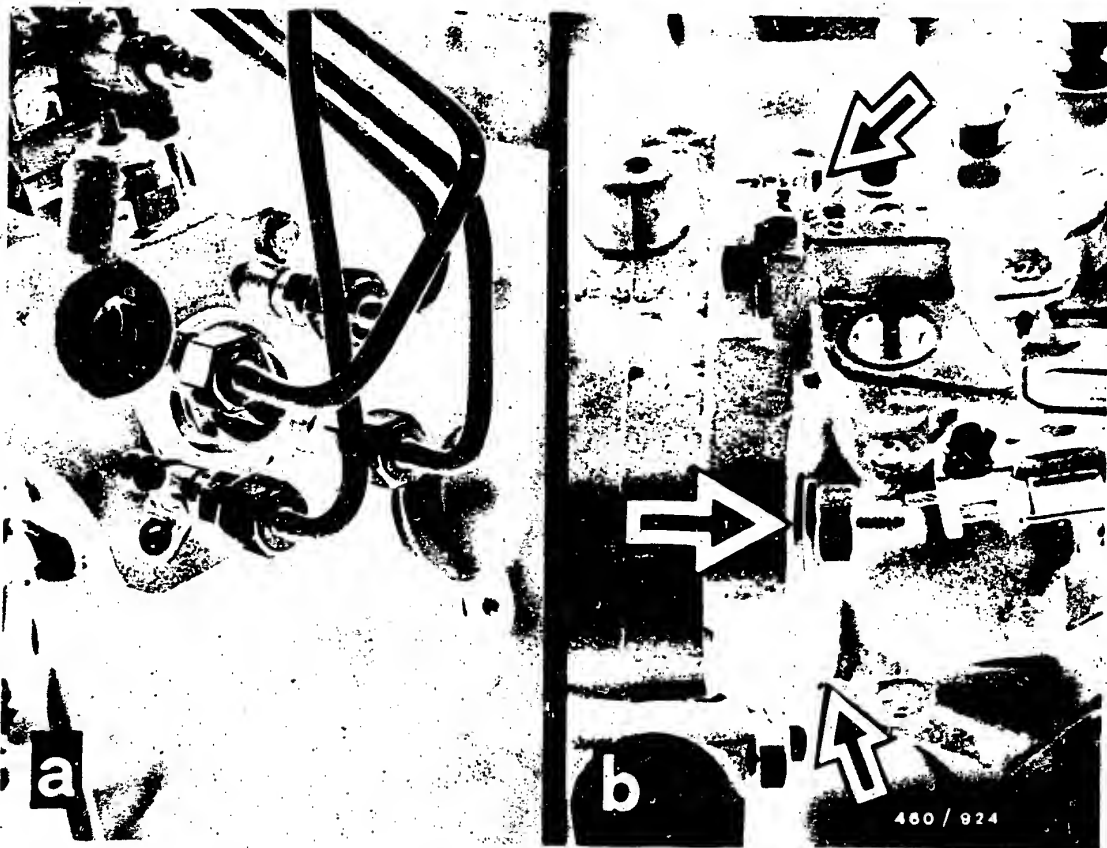
Loosen hose clips and pull off cooling-water hoses.

**D19**

Remove fuel-injection pump

Fiat Argenta 2500 Turbo-Diesel





Using box wrench KDEP 1115, loosen the fuel-injection lines. (Prevent the delivery-valve holders from becoming loose by holding them with a wrench.)

Remove fastening nuts (arrows) on the fuel-injection pump.

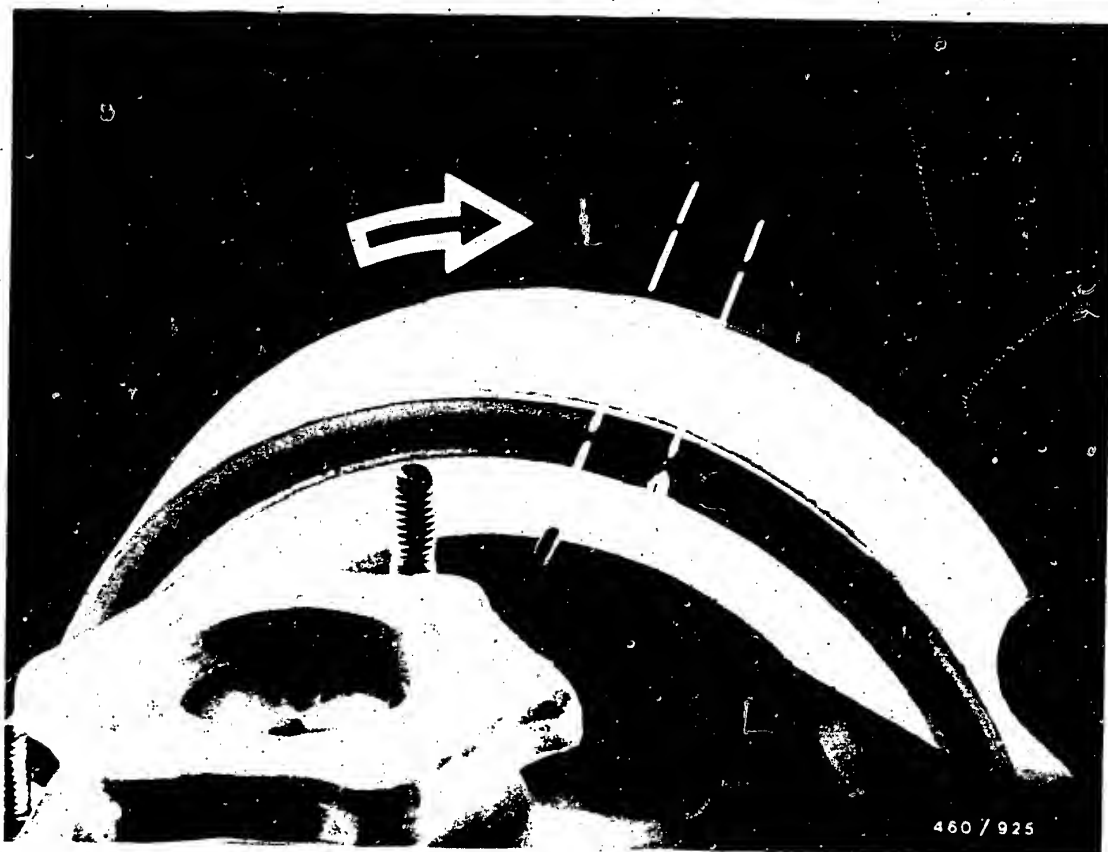
Remove fuel-injection pump from motor.

**D20**

Remove fuel-injection pump

Fiat Argenta 2500 Turbo-Diesel



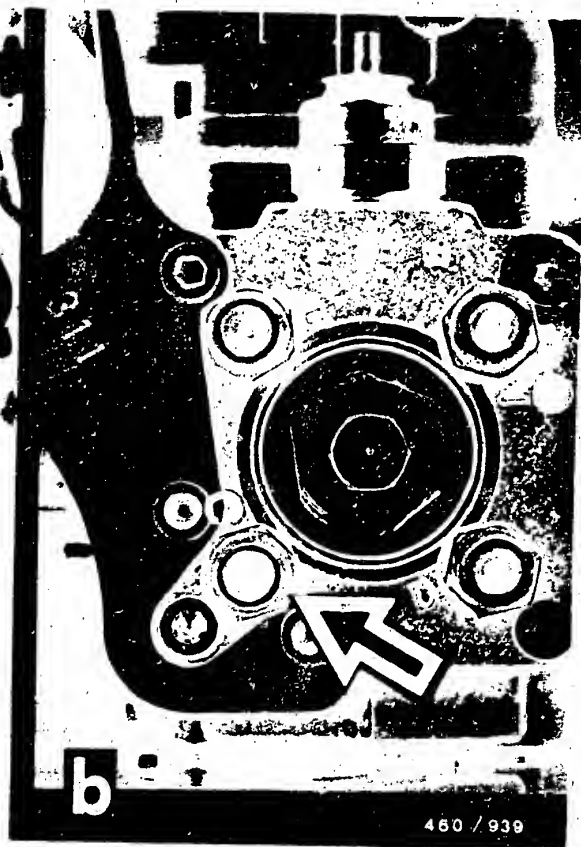
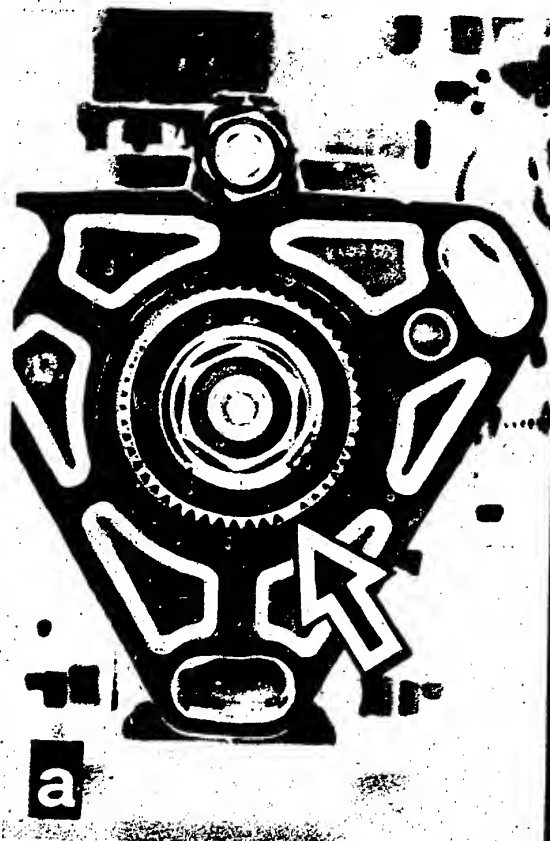


## 25. Install fuel-injection pump

Put cylinder head on provisionally.

Turn crankshaft counter to the direction of engine rotation (direction shown by arrow) until the mark on the camshaft gear is approx. 10 mm short of the reference mark on the cylinder cover.





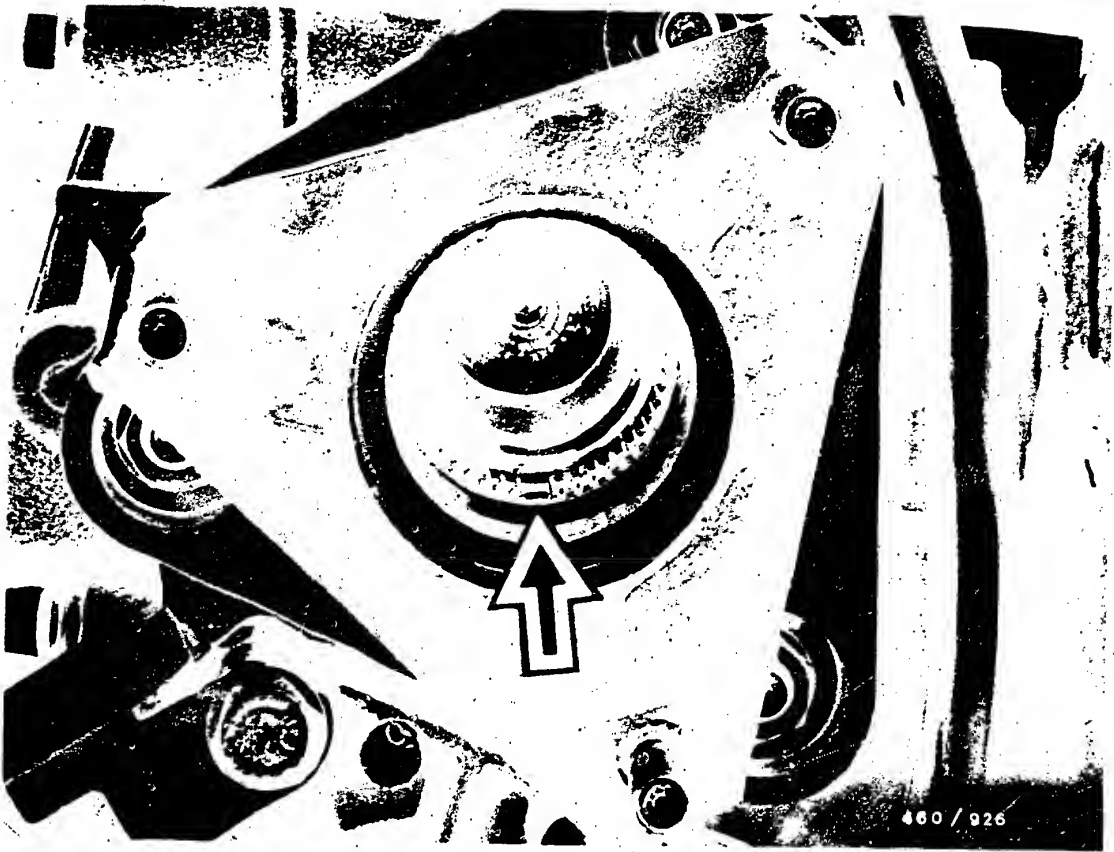
Before inserting the fuel-injection pump into the timing case, align the mark on the drive gear (illustration a-arrow) with outlet "C" (illustration b-arrow).

**D22**

Install fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel







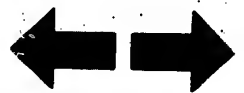
Place fuel-injection pump on the engine, introducing the mark on the fuel-injection pump gear at the missing tooth on the drive shaft (arrow).

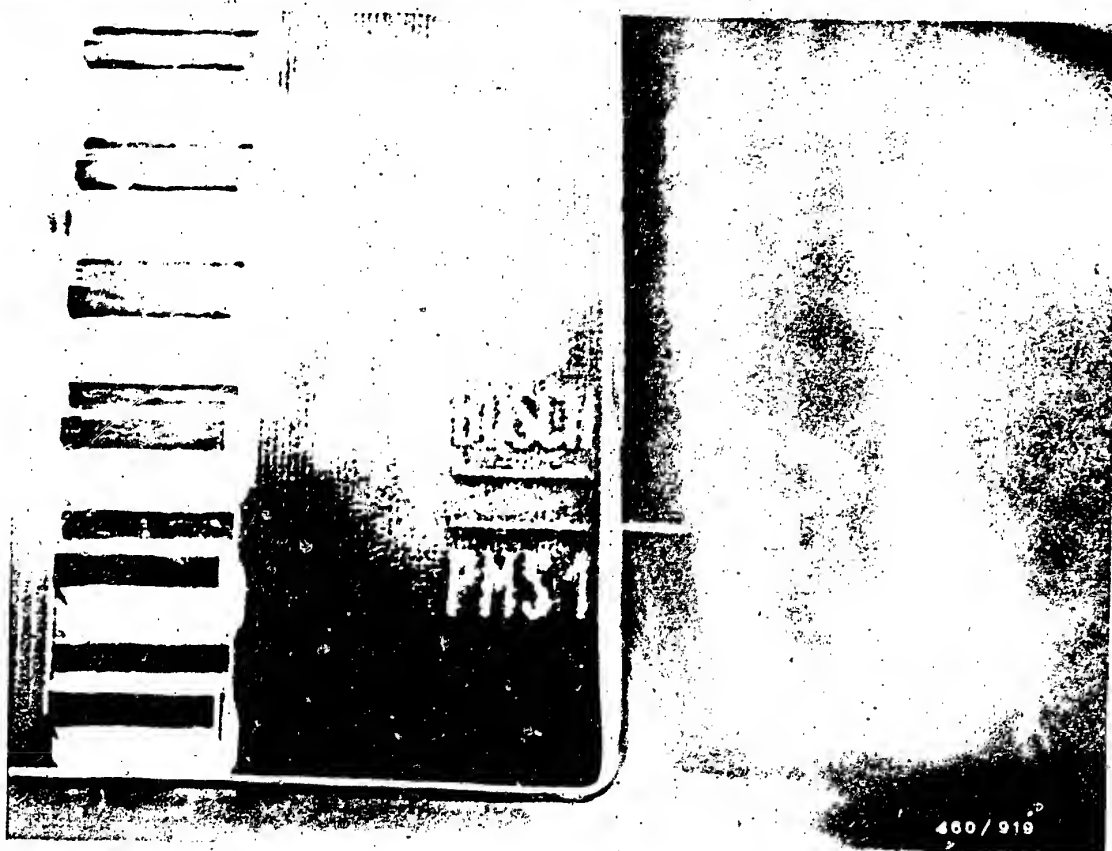
Pivot the fuel-injection pump into the middle position in the slots.

Screw on the fastening nuts and finger-tighten them.

**D23**

Install fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel



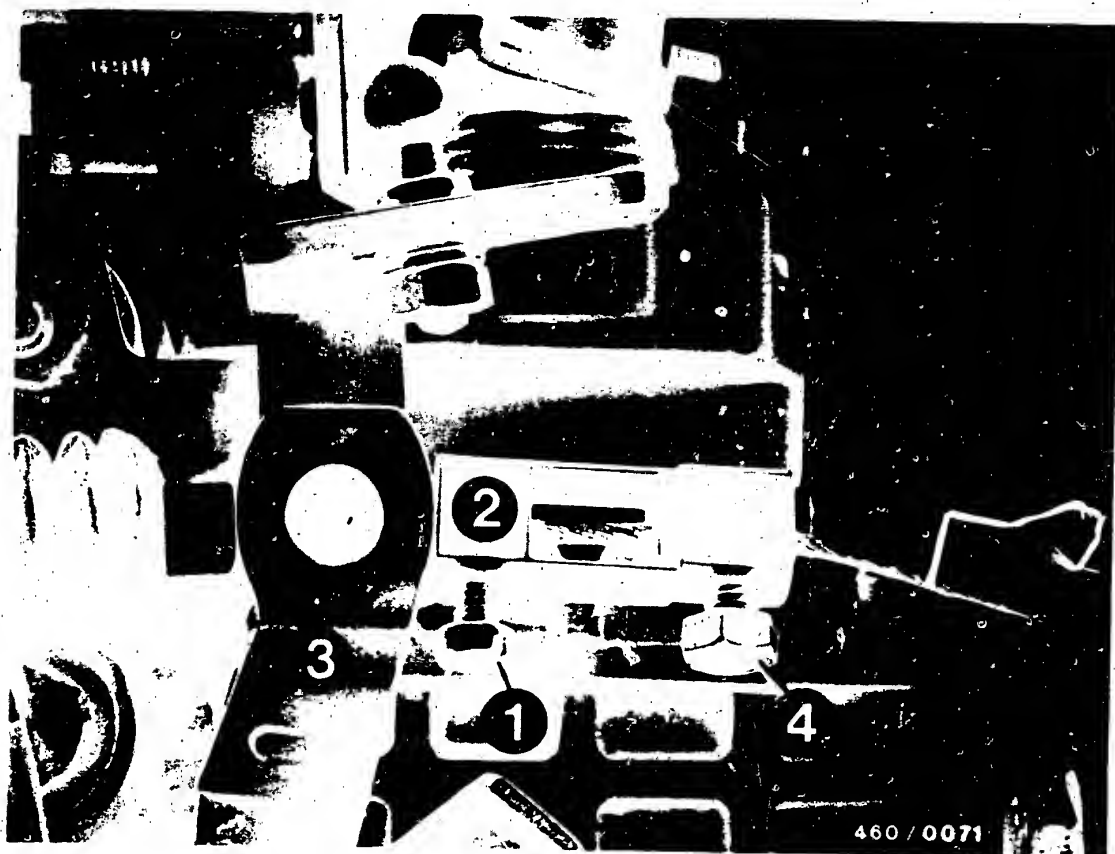


Turn the crankshaft in the direction of engine rotation, until the TDC-mark on the clutch housing aligns with the reference mark "PMS-1" on the flywheel.

**D24**

Install fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel





When testing and adjusting the start of delivery, the temperature-controlled cold-start accelerator must be in the zero position.

Loosen clamping screw (1) on injection pump.

Pull intermediate piece (2) with control lever (3) towards hydraulic head.

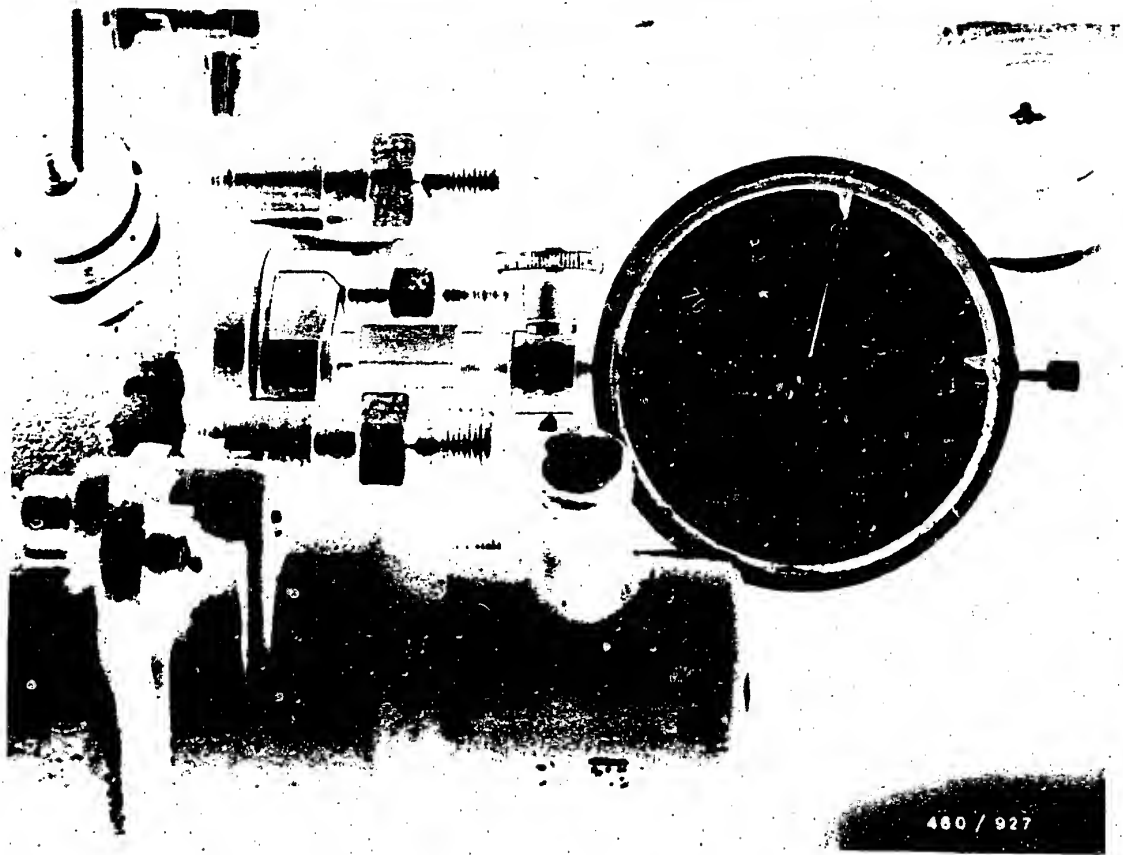
Turn intermediate piece (2) through  $90^\circ$  and push again toward drive shaft until control lever (3) is up against the stop bracket.

In this position, the control device is off.

Caution!

Locating screw (4) must not be loosened, since, otherwise, it will be necessary to reset the control device.





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Unscrew the bleeder screw from the central screw plug (triangular-head plug) on the hydraulic head.

Mount measuring tool KDEP 1085 and the dial indicator in the threaded hole.

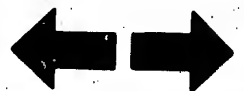
Preload the dial indicator by approx. 3 mm .

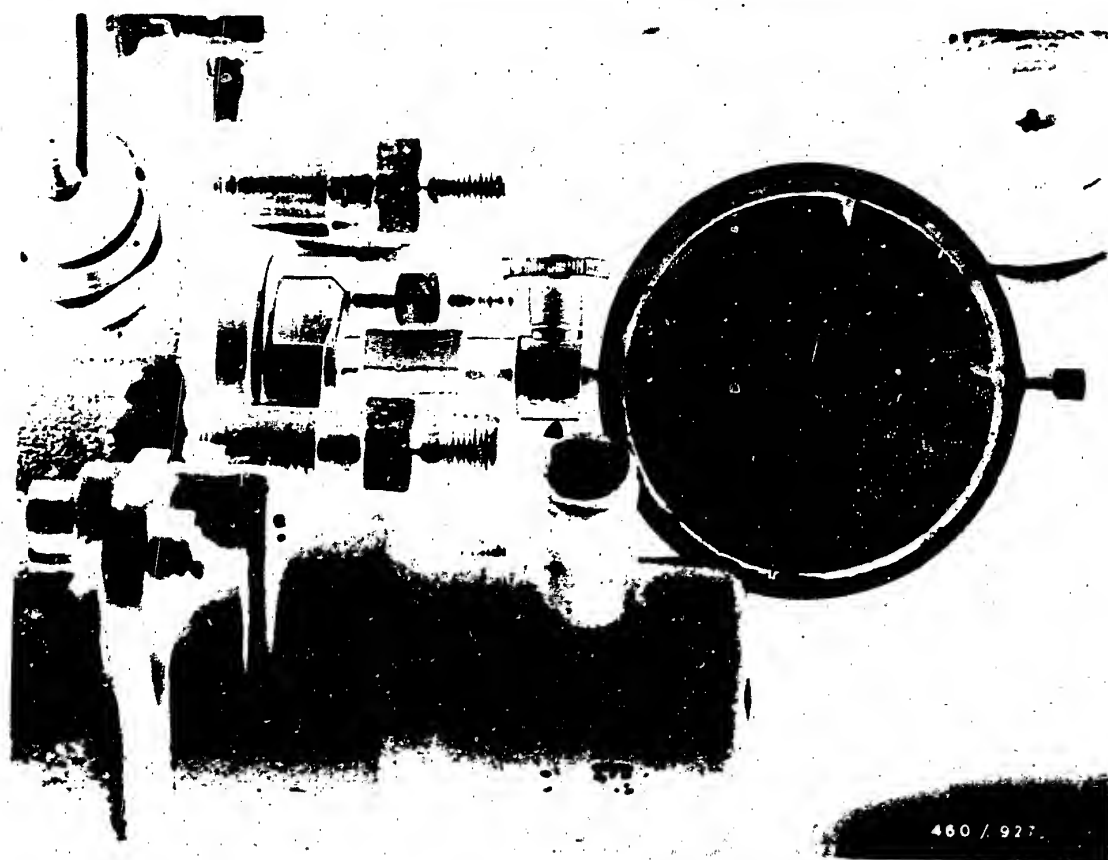
Slowly turn the crankshaft counter to the direction of engine rotation, until the needle on the dial indicator no longer moves.

Set the dial indicator at "0".

**E2**

Install fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel





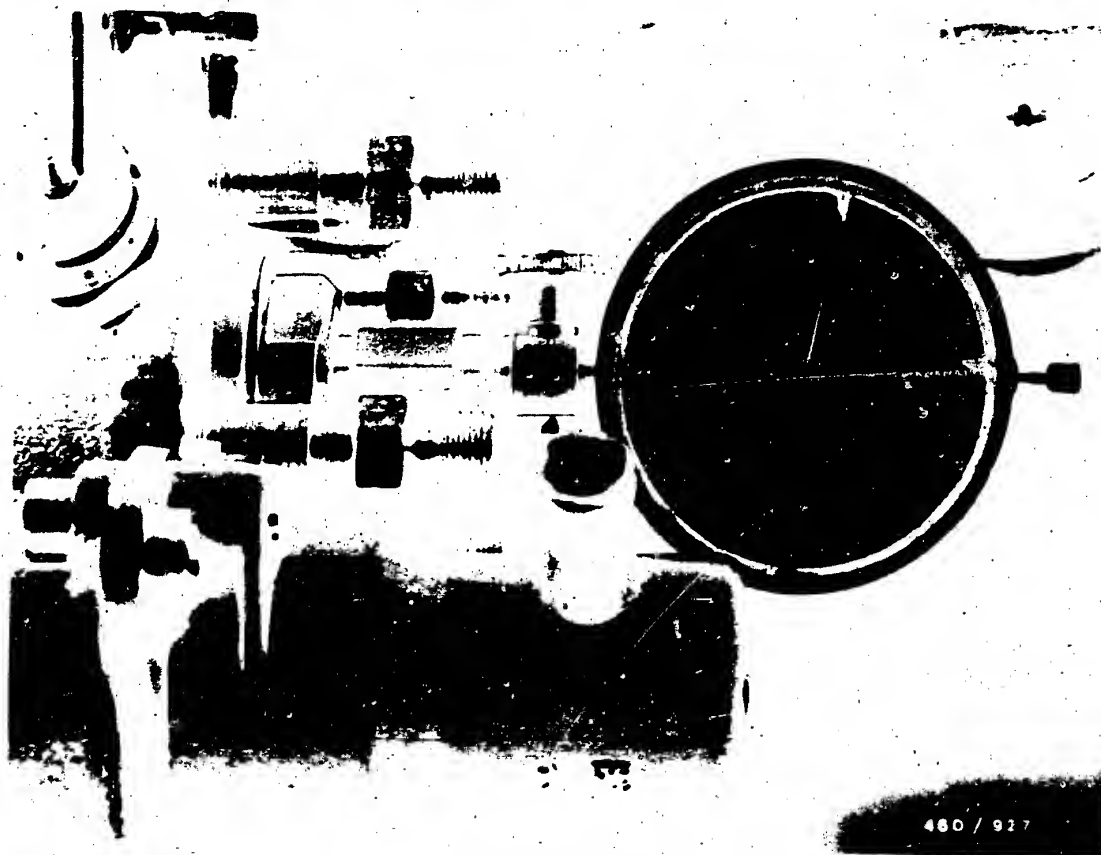
Turn the crankshaft in the direction of engine rotation, until the TDC-mark on the clutch housing aligns with the reference mark "PMS-1" on the flywheel.

In this position, the dial indicator must show a pump plunger stroke of 0.90 mm ABDC.

**E3**

Install fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel





If a correction is needed, loosen fastening screws on the fuel-injection pump.

Pivot the fuel-injection pump until a pump piston stroke of 0.90 mm ABDC is reached.

Tighten fastening screws to 25 Nm.

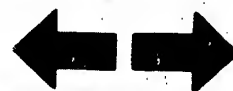
Rotate crankshaft twice and re-check the adjustment.

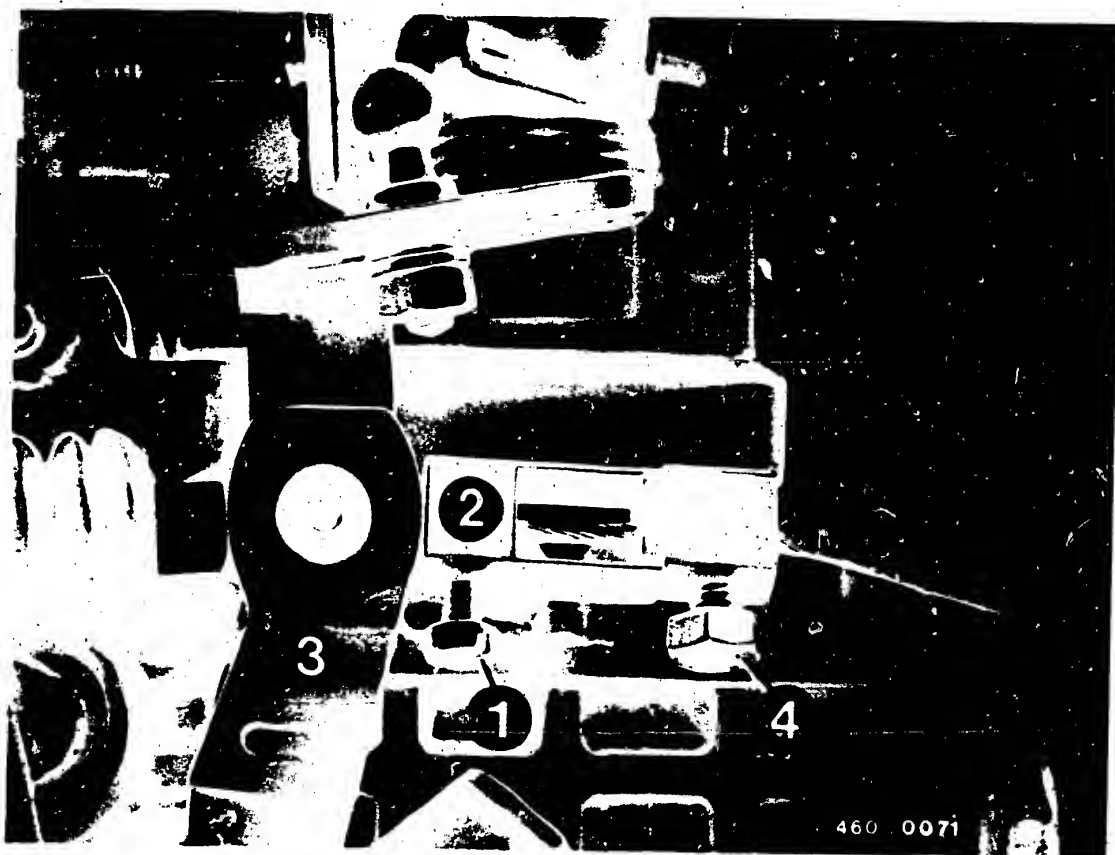
Remove measuring tool KDEP 1085 and dial indicator.

Mount bleeder screw using a new seal ring.

**E4**

Install fuel-injection pump  
Fiat Argenta 2500 turbo-Diesel





Pull control lever (3) with intermediate piece (2) toward hydraulic head.

Turn intermediate piece (2) through 90° and push again toward drive shaft.

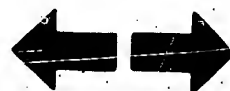
Intermediate piece is in starting position (picture).

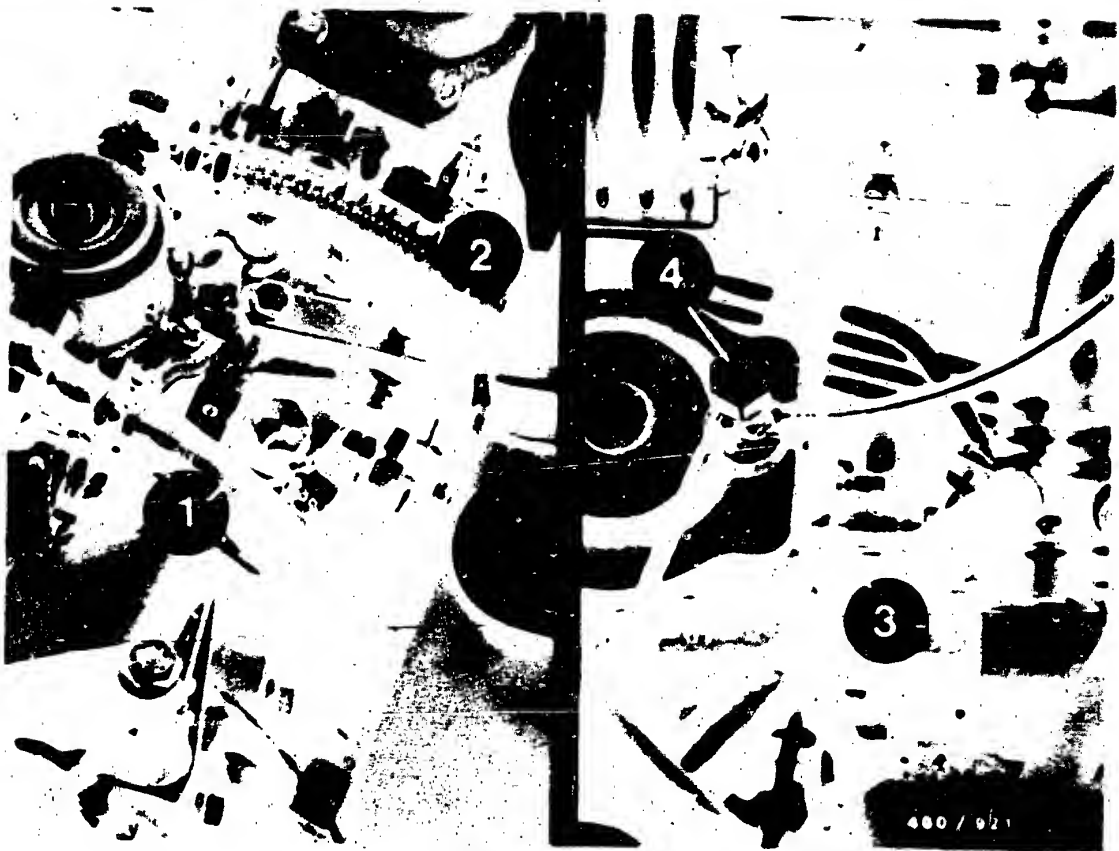
Tighten clamping screw (1).

**E5**

Install fuel-injection pump

Fiat Argenta 2500 Turbo-Diesel



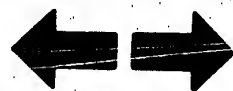


Put on fuel inlet line (1), cable on control-lever (2), fuel return line (3), and pressure line (4) to the manifold-pressure compensator housing.

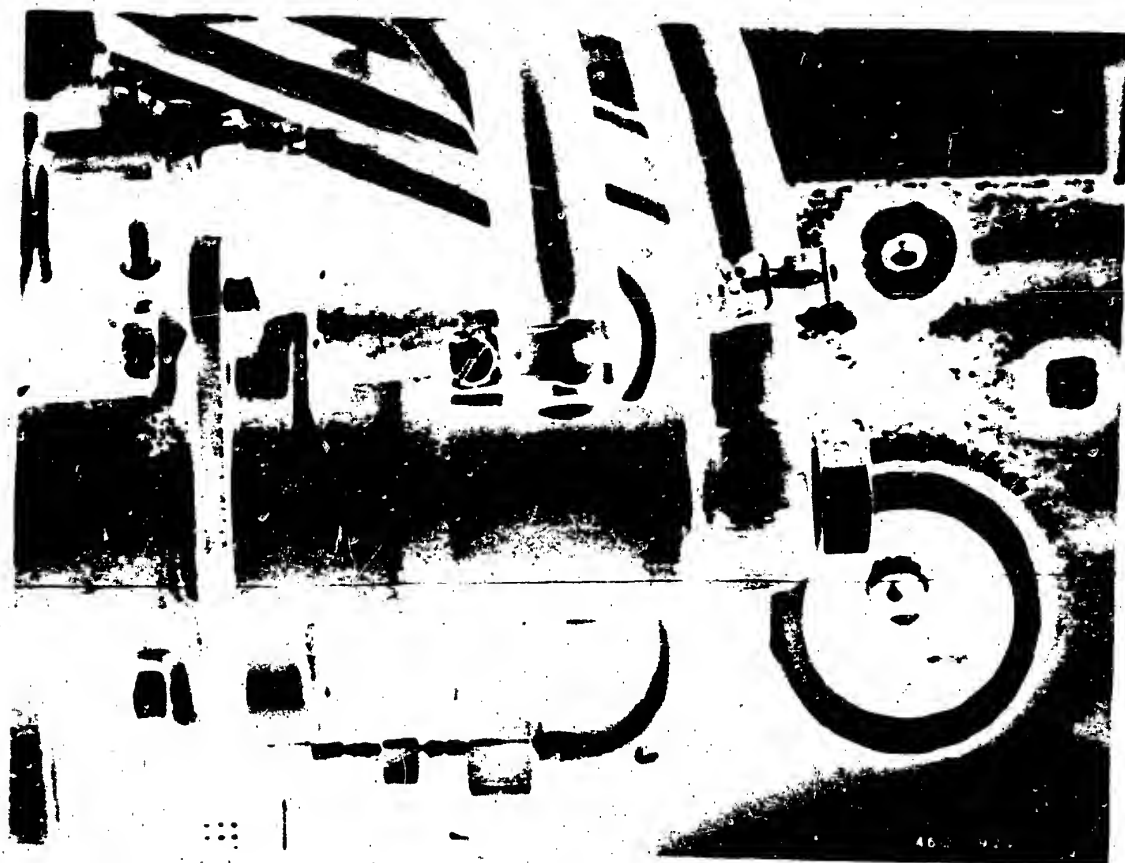
Put on the lead for the electrical shutoff device.

**E6**

Install fuel-injection pump  
Fiat Argenta 2500 turbo-Diesel







Connect cooling water hoses to the control device for the fuel-injection pump and remove the hose clamber.

Tighten the hose clamps.

Put on fuel-injection lines.

(Keep the pressure-valve holders from turning by holding them with a wrench.)

Note:

Do not mistake the inlet-unions screws of the fuel inlet lines and the fuel return lines, one for the other.

The inlet-union screw of the return has restriction holes and is identified on the screw head with the word "Out".

**E7**

Install fuel-injection pump

Fiat Argenta 2500 Turbo-Diesel





Mount the crankcase breather (arrow).

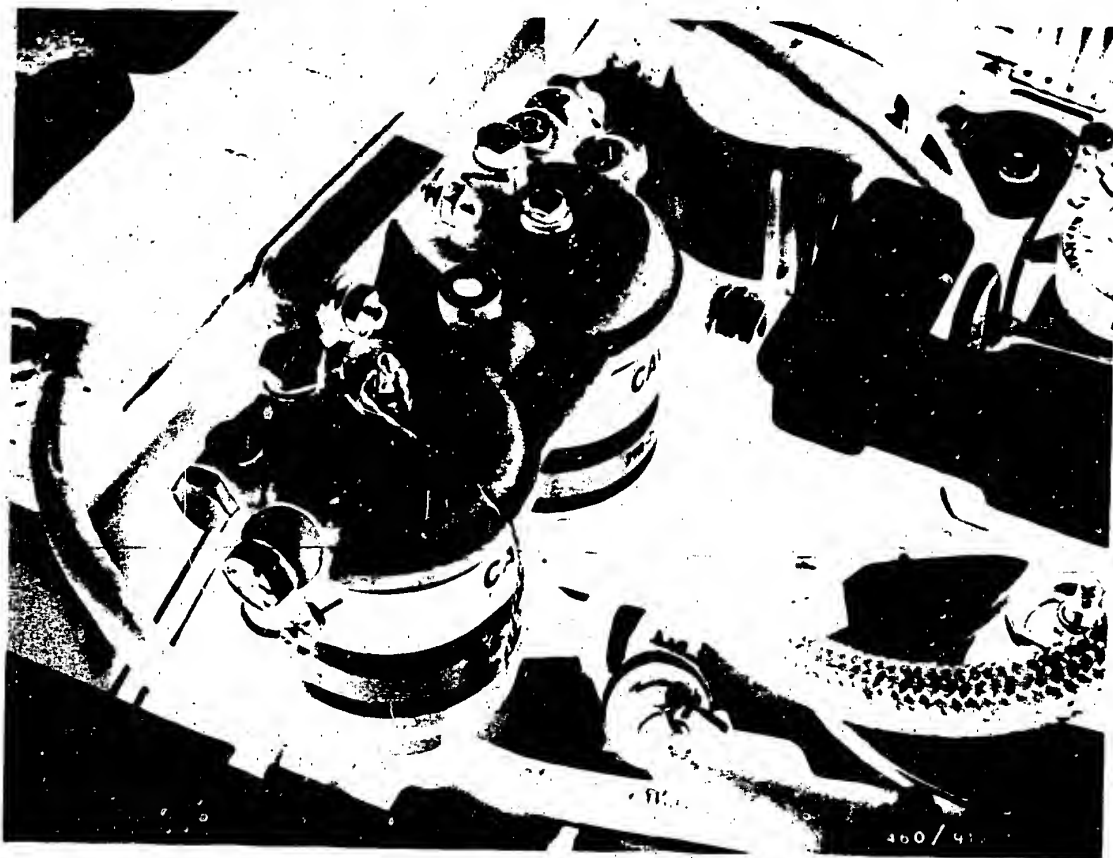
Put on the cylinder head cover.

Connect negative lead to battery.

**E8**

Install fuel-injection pump.  
Fiat Argenta 2500 Turbo-Diesel





### 25.1 Bleed fuel system

Fill the fuel filter and injection pump with diesel fuel.

Tighten hose connections on filter cover.

**E9**

Install fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel





Loosen union nuts of fuel-injection tubing on nozzle-holder assemblies.

Operate starting motor without preheating until fuel escapes from union nuts of nozzle-holder assemblies (arrow).

Tighten union nuts.

Operate starting motor until engine starts.

**E10**

Install fuel-injection pump  
Fiat Argenta 2500 Turbo-Diesel



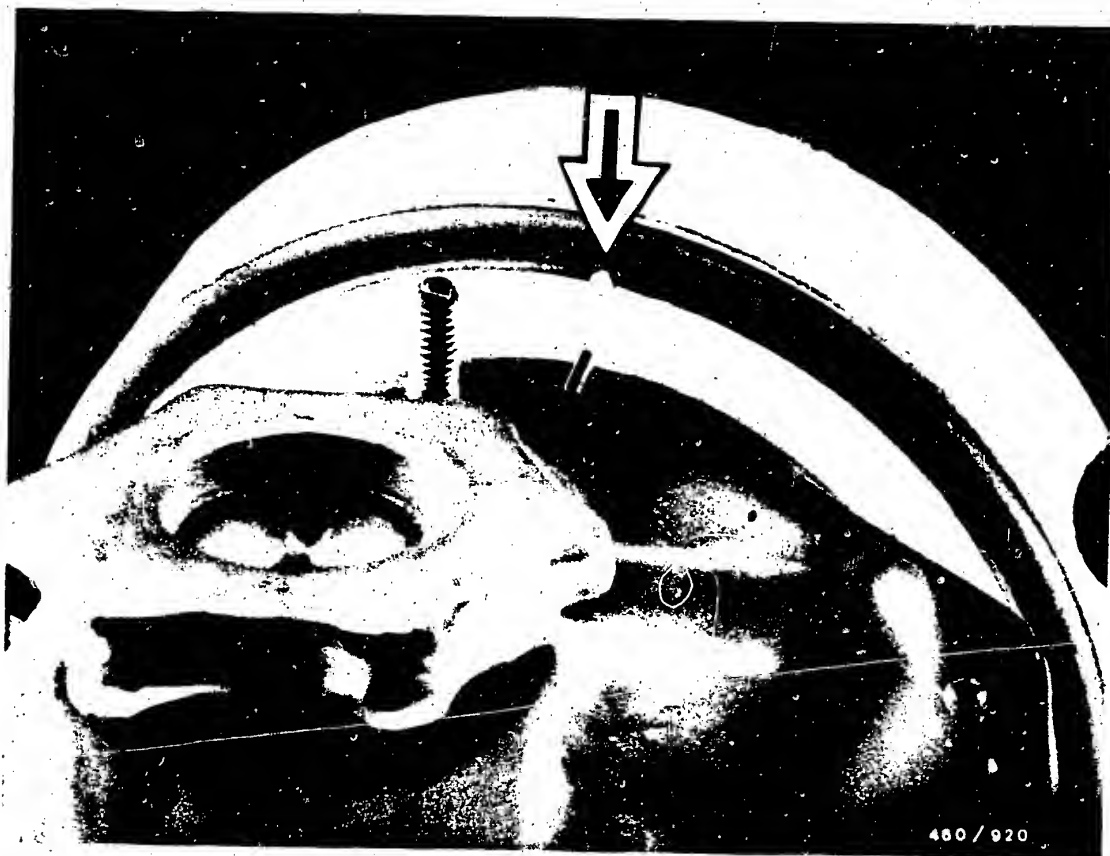


## 26. Test and adjust engine timing

### 26.1 Test engine timing

Turn the crankshaft in the direction of engine rotation until the TDC mark on the clutch housing aligns with the reference mark "PMS-1" on the flywheel.

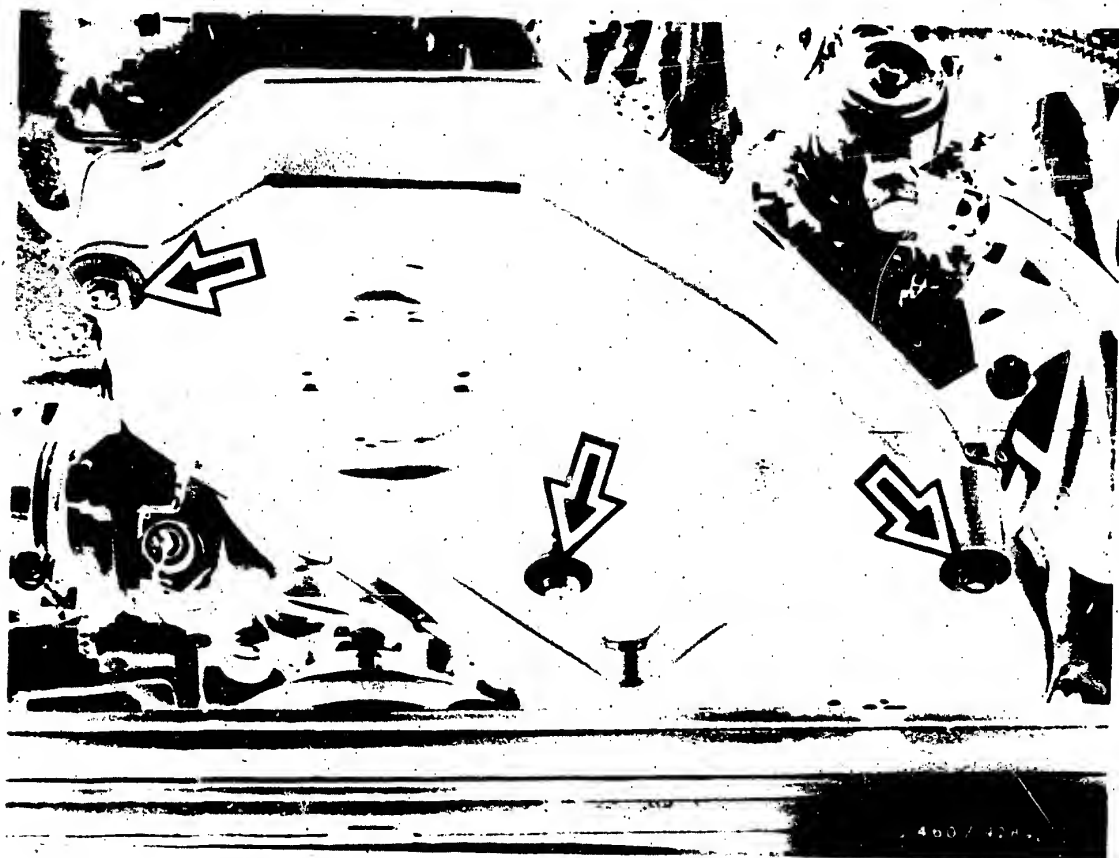




The mark on the camshaft gear and the reference mark on the cylinder head cover (arrow) must align.

Take off the cylinder head cover.

1. Cylinder 1 on compression stroke (valves of cylinder 4 on overlap).

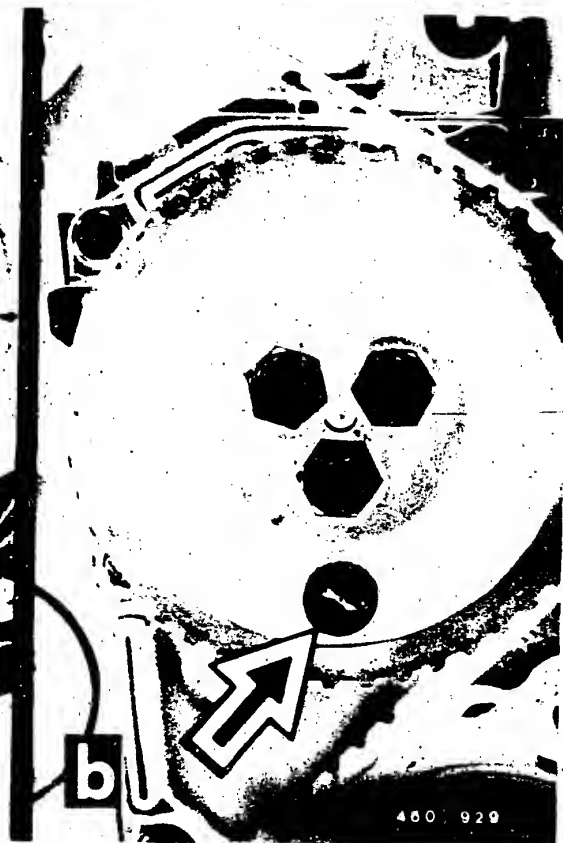


Remove fastening screws from the toothed-belt guard case (arrows) and take off the guard case.

**E13**

Test and adjust engine timing  
Fiat Argenta 2500 Turbo-Diesel





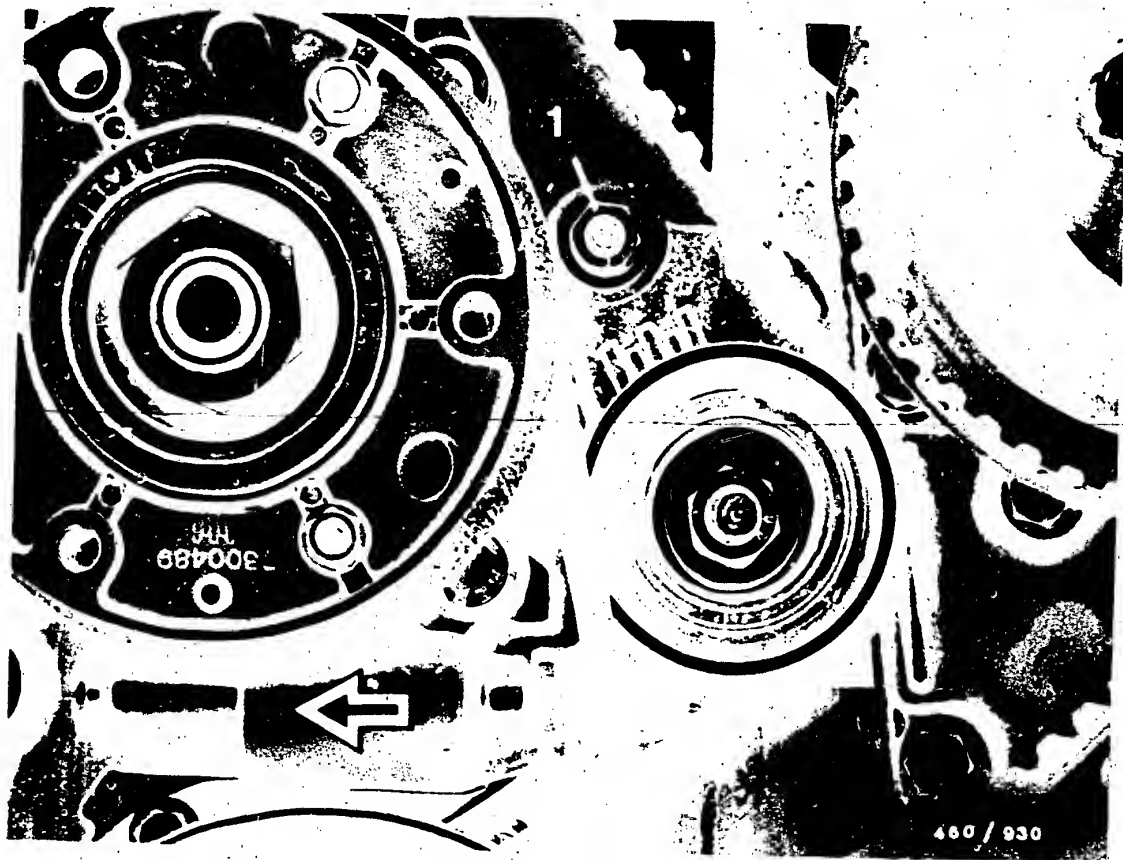
Fix the crankshaft pulley and fuel-injection drive gear in place using 5 mm locating pins (user-fabricated) (arrows).

If the locating pins cannot be put in, correct the engine timing.

Note:

5 mm punches or 5 mm drill bits can be used as locating pins.





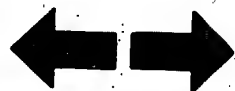
## 26.2 Adjust engine timing

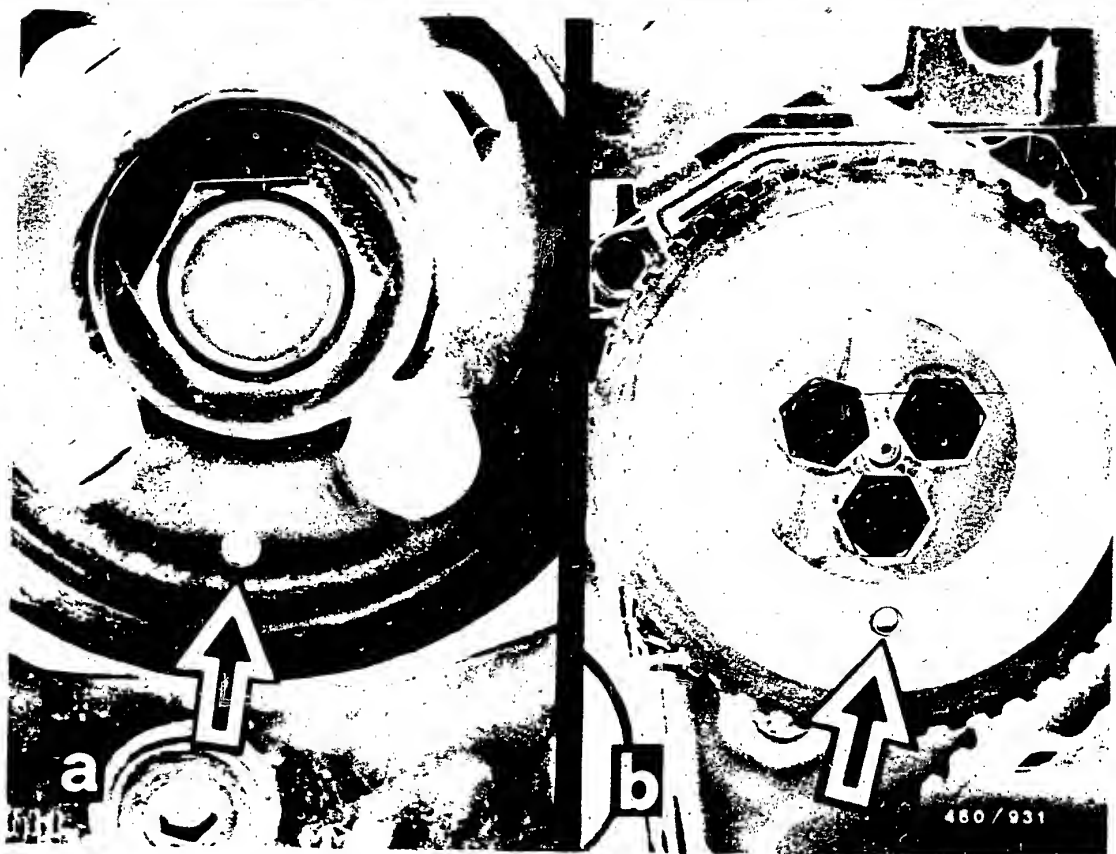
Loosen fastening screw (1) on the toothed-belt tensioner.

Press the toothed-belt tensioner in the direction shown by the arrow until reaching the stop.

Lighten fastening screw (1).

Remove toothed-belt from the camshaft gear and the fuel-injection pump gear.



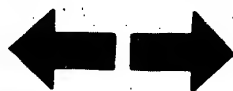


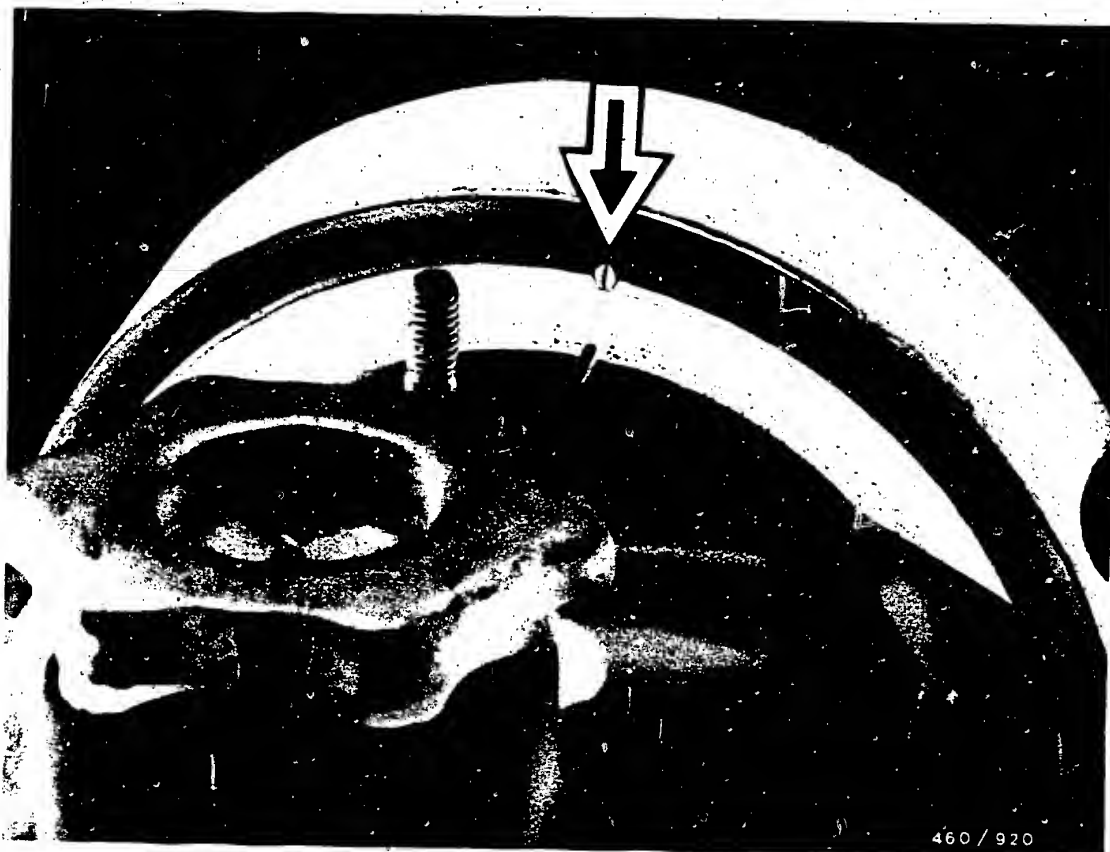
Turn the crankshaft pulley (illustration a) and the fuel-injection pump gear (illustration b) to the locating hole (arrows) and fix in place using locating pins.

**E16**

Test and adjust engine timing

Fiat Argenta 2500 Turbo-Diesel





Put cylinder head cover on provisionally.

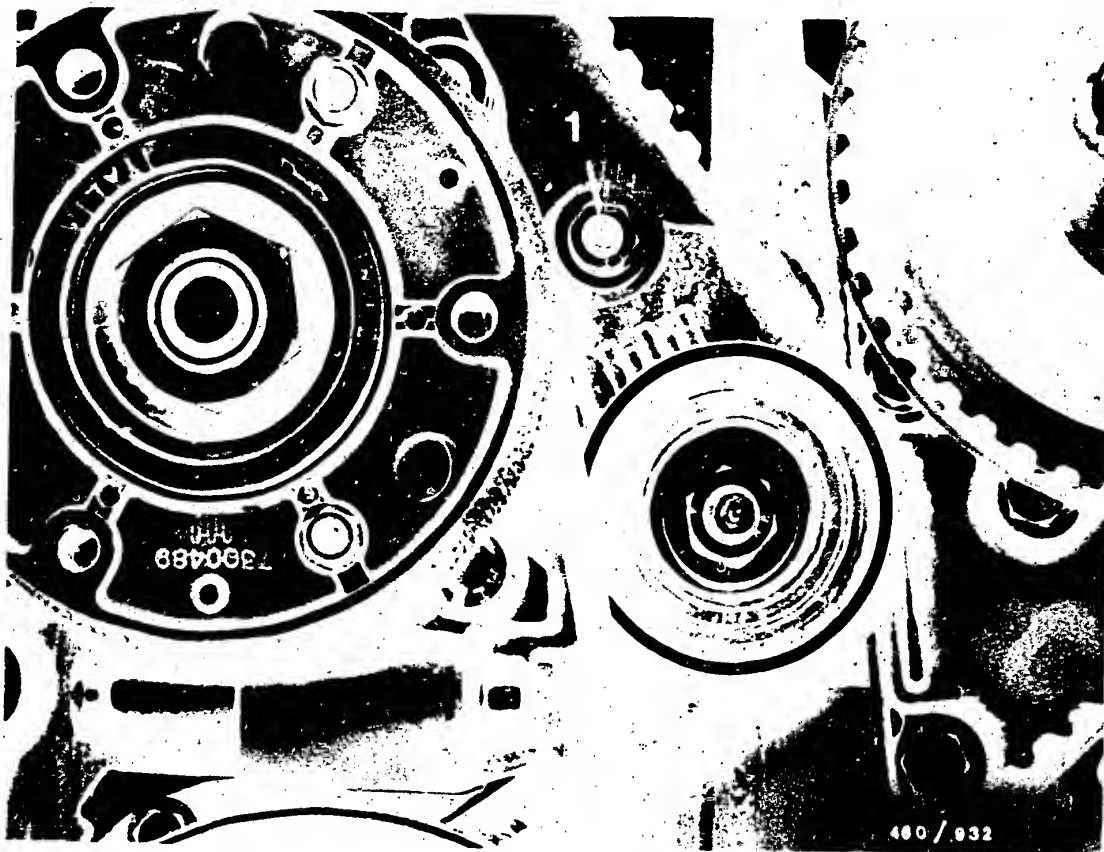
Turn the camshaft gear to the reference mark on the cylinder head cover (arrow).

Put on the toothed-belt.

**E17**

Test and adjust engine timing  
Fiat Argenta 2500 Turbo-Diesel





Loosen fastening screw (1) on the toothed-belt tensioner.

Toothed-belt is tensioned automatically by the built-in spring.

Loosen screw (1) of the toothed-belt tensioner.

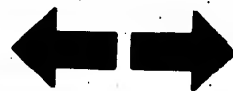
Remove locating pins.

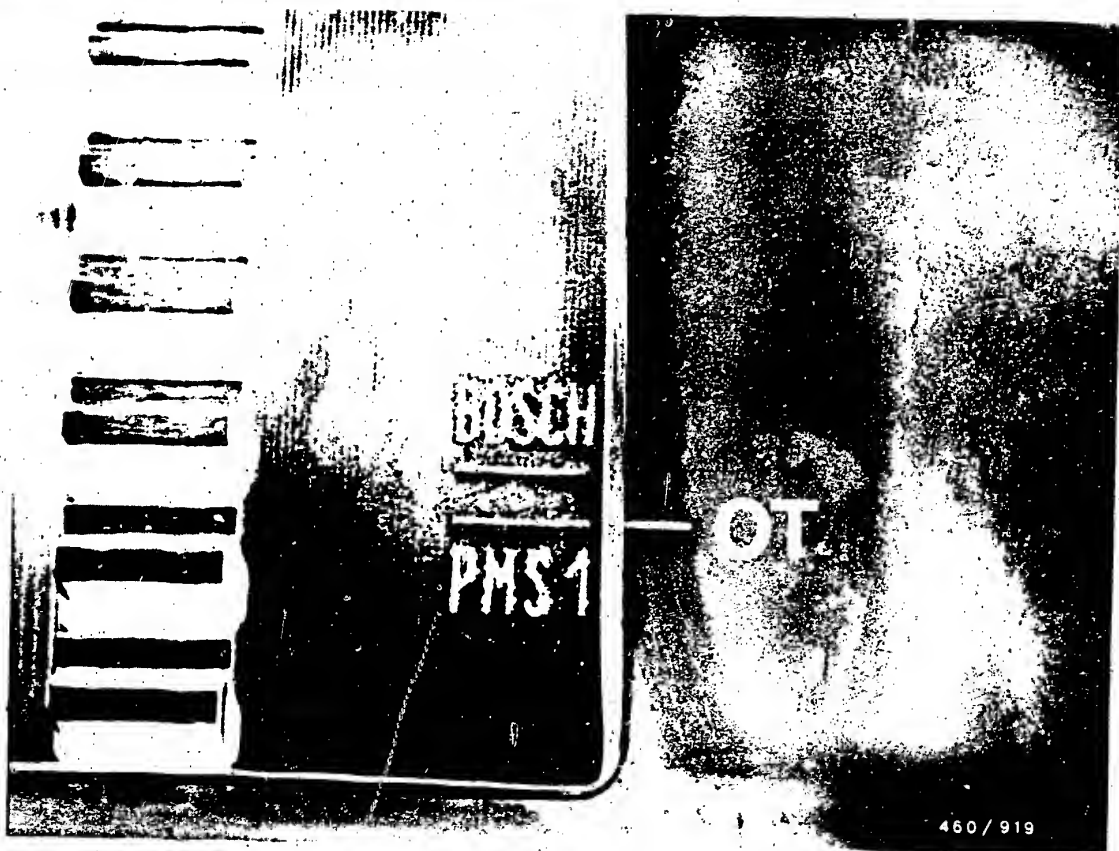
Rotate crankshaft two turns in the direction of engine rotation.

Loosen toothed-belt tensioner and re-tighten to 25 Nm.

**E18**

Test and adjust engine timing  
Fiat Argenta 2500 Turbo-Diesel



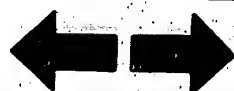


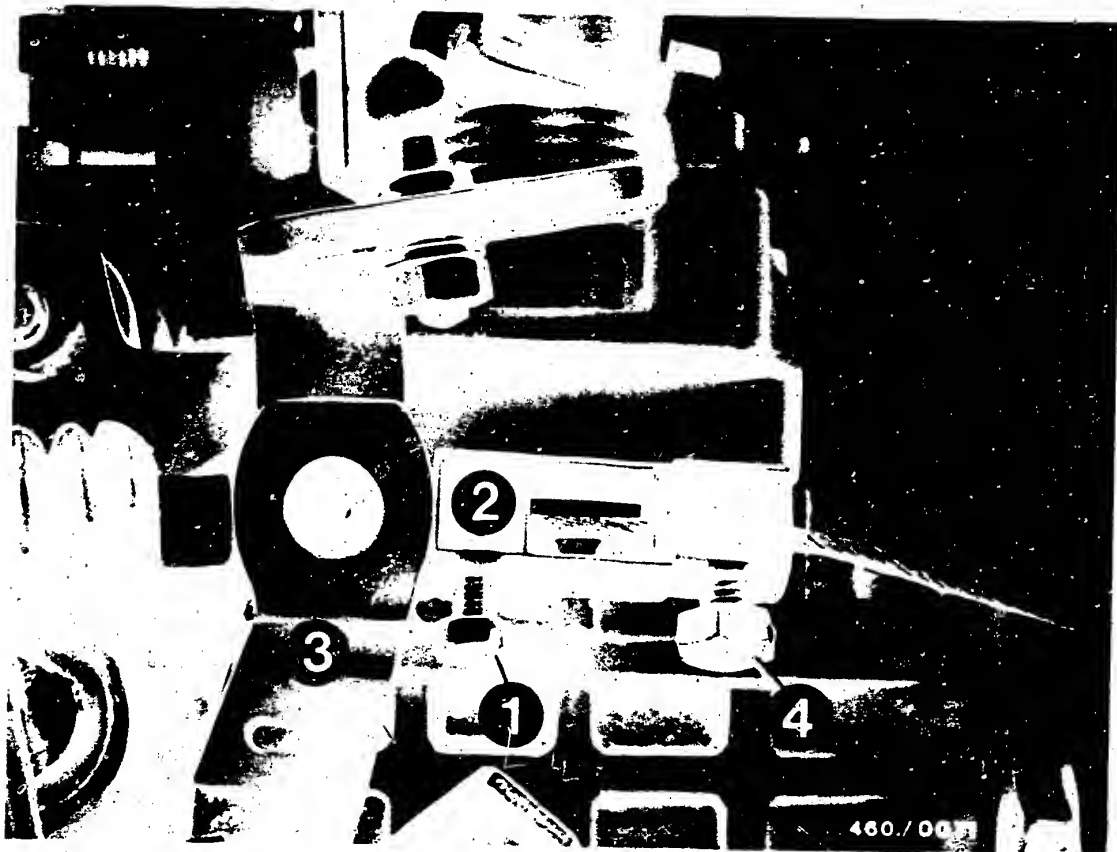
Turn the crankshaft in the direction of engine rotation until the TDC-mark on the clutch housing aligns with the reference mark "PMS-1" on the flywheel.

Remove fuel-injection lines on the fuel-injection pump and nozzle-holder assemblies. (Keep the delivery valves from loosening by holding them with a wrench.)

**E19**

Test and adjust engine timing  
Fiat Argenta 2500 Turbo-Diesel





When testing and adjusting the start of delivery, the temperature-controlled cold-start accelerator must be in the zero position.

Loosen clamping screw (1) on injection pump.

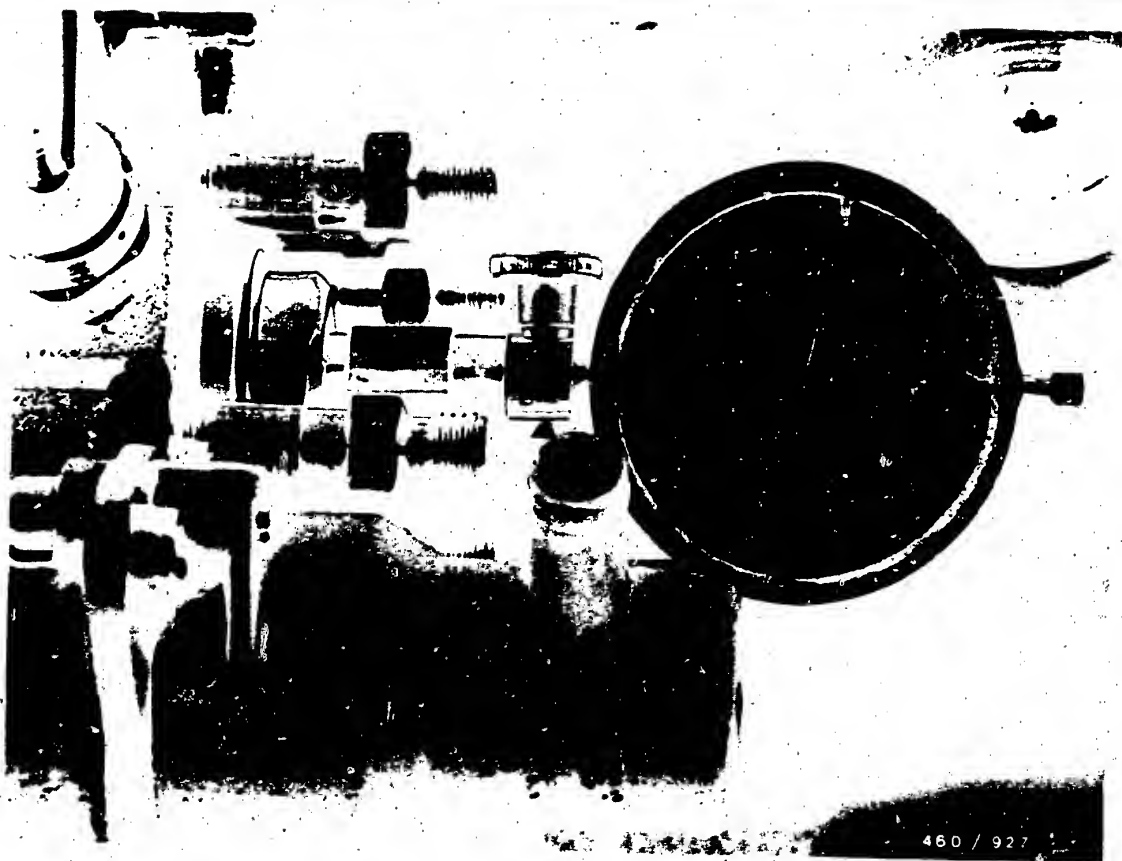
Pull intermediate piece (2) with control lever (3) towards hydraulic head.

Turn intermediate piece (2) through 90° and push again toward drive shaft until control lever (3) is up against the stop bracket.

In this position, the control device is off.

**Caution!**

Locating screw (4) must not be loosened, since, otherwise, it will be necessary to reset the control device.



Unscrew the bleeder screw from the central screw plug (triangular-head plug) on the hydraulic head.

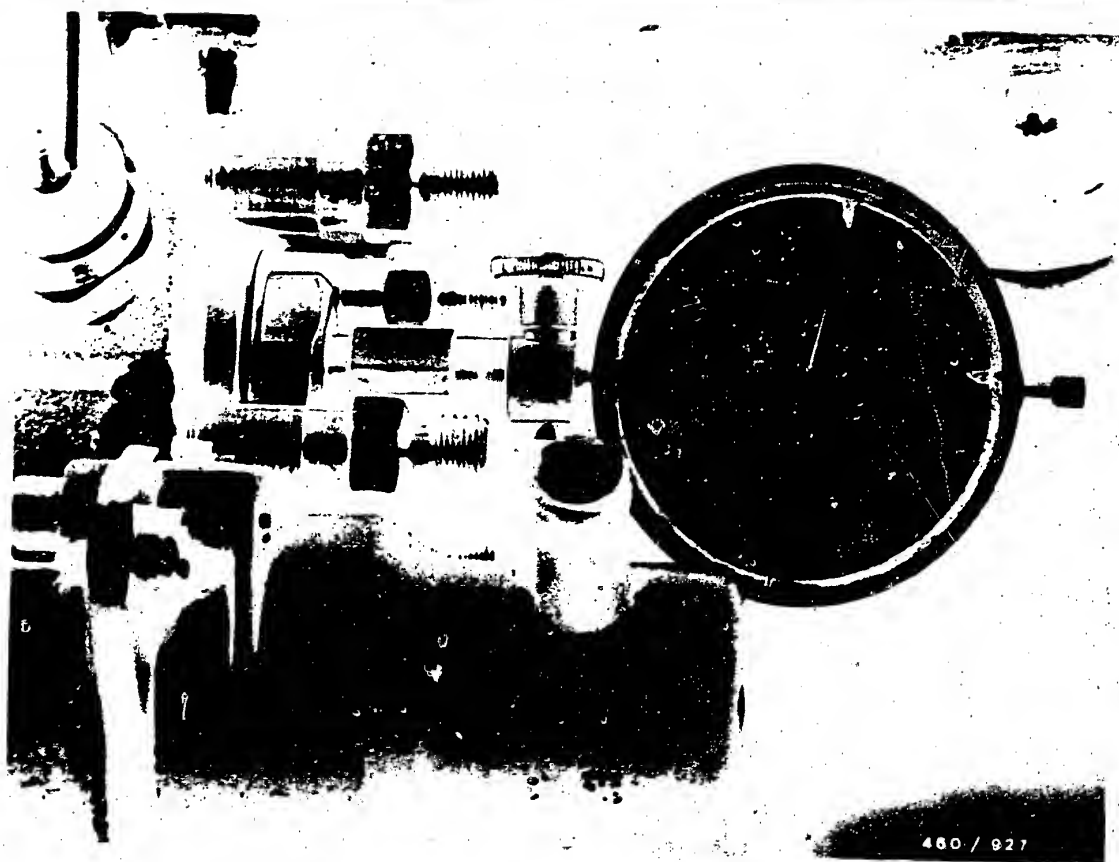
Mount measuring tool KDEP 1085 and the dial indicator in the threaded hole.

Preload the dial indicator by approx. 3 mm.

Slowly turn the crankshaft counter to the direction of engine rotation, until the needle on the dial indicator no longer moves.

Set the dial indicator at "0".

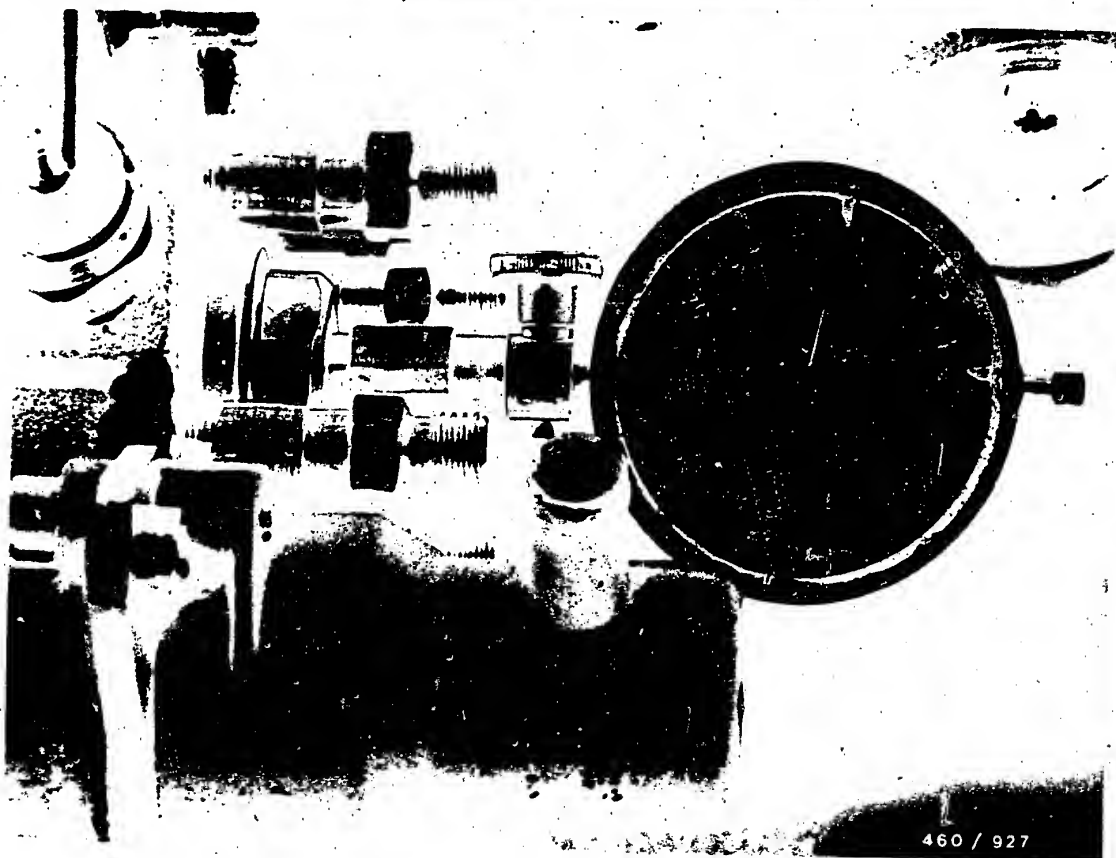




Turn the crankshaft in the direction of engine rotation, until the TDC-mark on the clutch housing aligns with the reference mark "PMS-1" on the flywheel.

In this position, the dial indicator must show a pump plunger stroke of 0.90 mm ABDC.





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If a correction is needed, loosen fastening screws on the fuel-injection pump.

Pivot the fuel-injection pump until a pump piston stroke of 0.90 mm ABDC is reached.

Tighten fastening screws to 25 Nm.

Rotate crankshaft twice and re-check the adjustment.

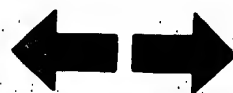
Remove measuring tool KDEP 1085 and dial indicator.

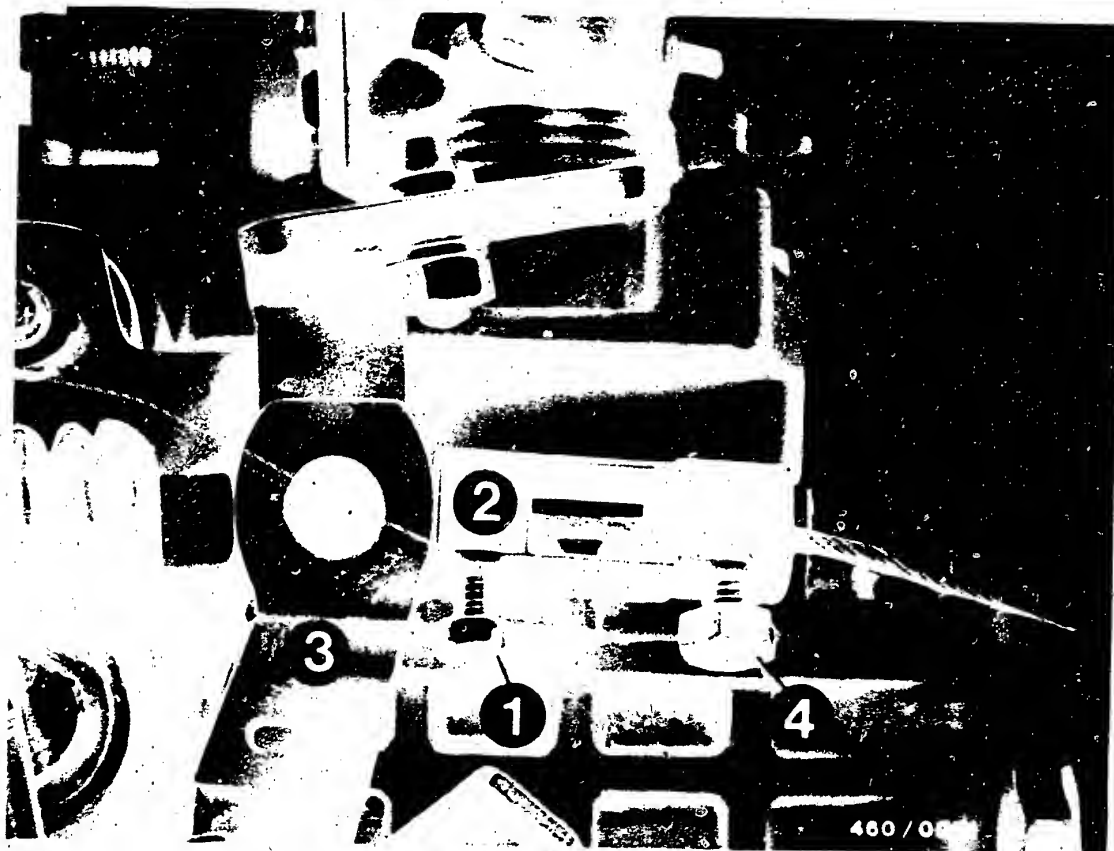
Mount bleeder screw using a new seal ring.

**E23**

Test and adjust engine timing

Fiat Argenta 2500 Turbo-Diesel





Pull control lever (3) with intermediate piece (2) toward hydraulic head.

Turn intermediate piece (2) through 90° and push again toward drive shaft.

Intermediate piece is in starting position (picture).

Tighten clamping screw (1).



Put on the cylinder head cover and the toothed-belt guard case.

Tighten fuel-injection lines using box wrench KDEP 1115. (Keep the delivery valve holders from turning by holding them with a wrench).

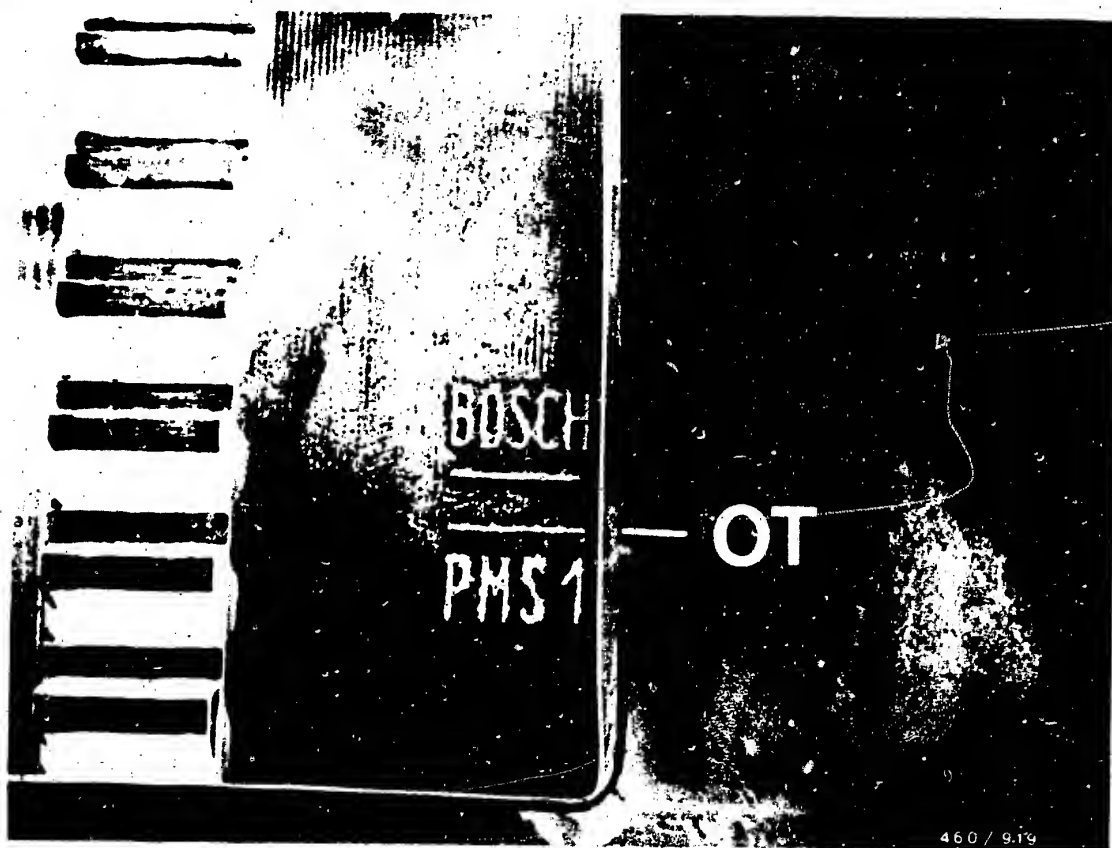
Bleed the fuel system.

**F1**

Test and adjust engine timing

Fiat Argenta 2500 Turbo-Diesel

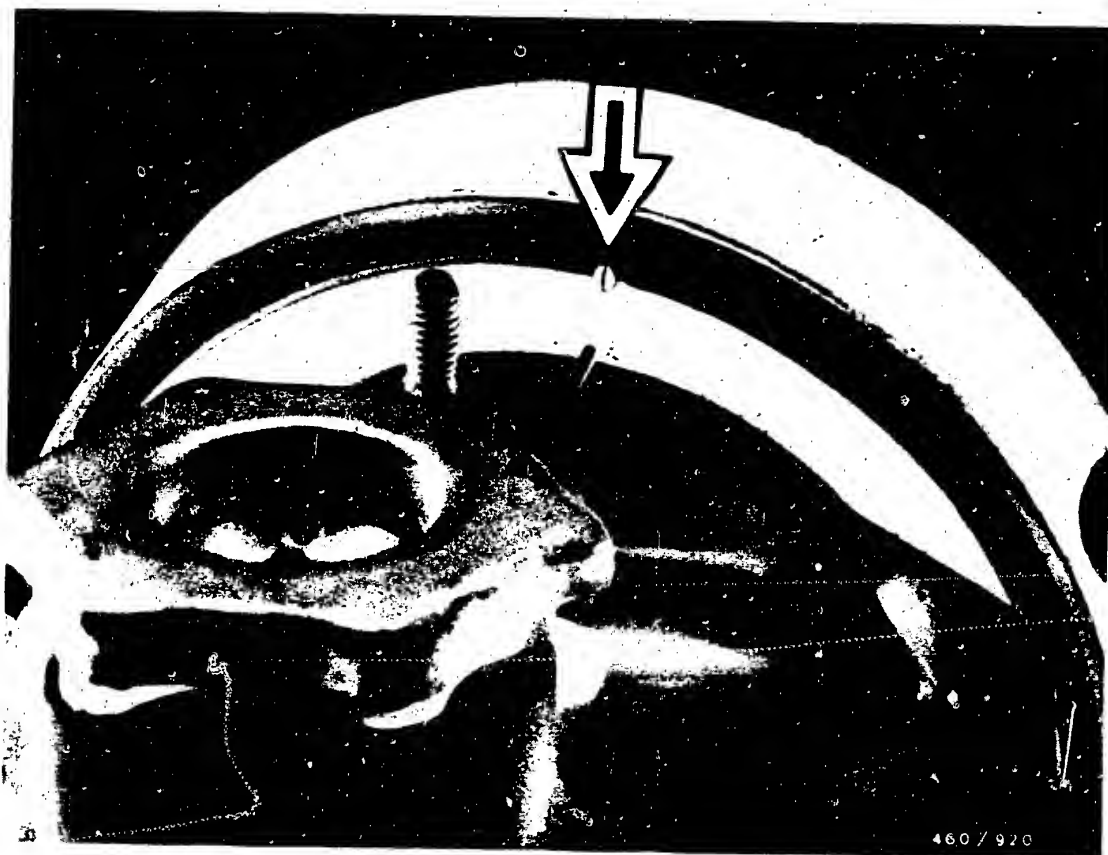




### 27. Injection timing

Turn the crankshaft in the direction of engine rotation until the TDC-mark on the clutch housing aligns with the reference mark "PMS-1" on the flywheel.



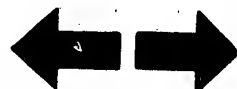


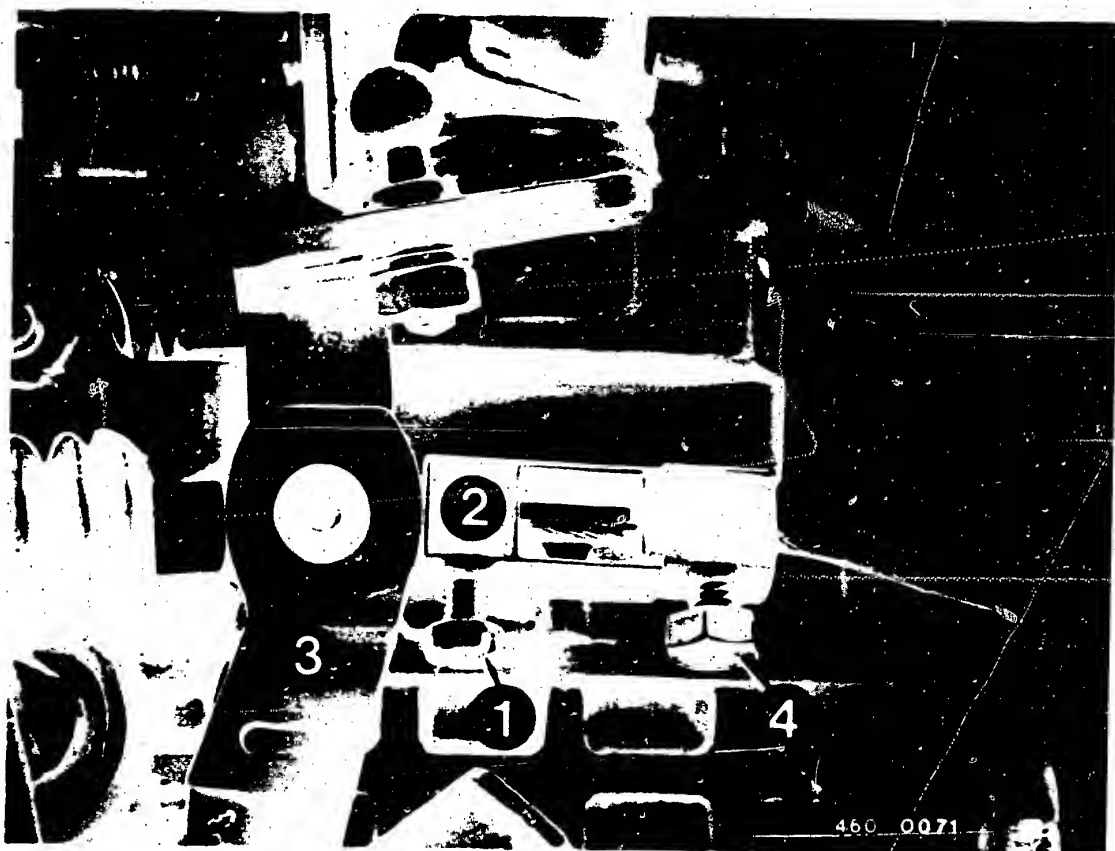
The mark on the camshaft gear and the reference mark on the cylinder head cover (arrow) must align.

Take off the cylinder head cover.

1. Cylinder 1 on compression stroke (valves of cylinder 4 on overlap).

Remove fuel-injection lines on the fuel-injection pump and the nozzle holder assemblies. (Keep the delivery valve holders from loosening by holding them with a wrench.)





When testing and adjusting the start of delivery, the temperature-controlled cold-start accelerator must be in the zero position.

Loosen clamping screw (1) on injection pump.

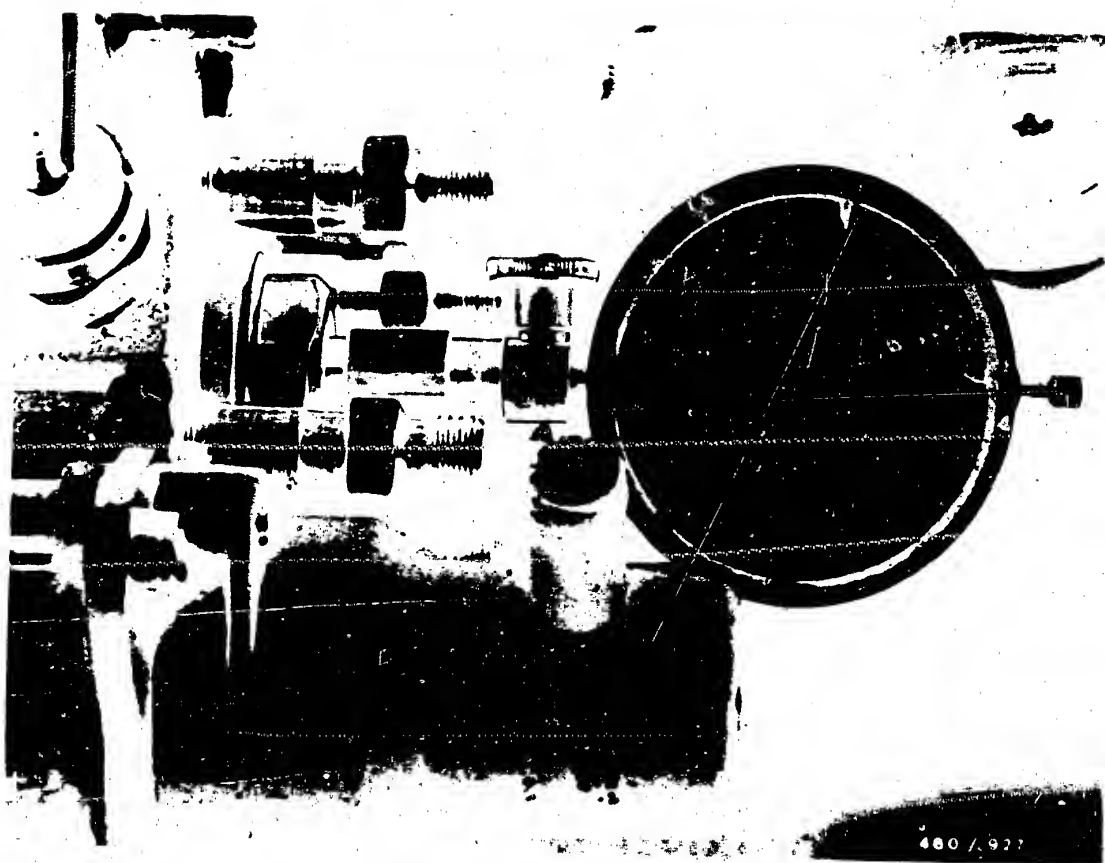
Pull intermediate piece (2) with control lever (3) towards hydraulic head.

Turn intermediate piece (2) through 90° and push again toward drive shaft until control lever (3) is up against the stop bracket.

In this position, the control device is off.

**Caution!**

Locating screw (4) must not be loosened, since, otherwise, it will be necessary to reset the control device.



Unscrew the bleeder screw from the central screw plug (triangular-head plug) on the hydraulic head.

Mount measuring tool KDEP 1085 and the dial indicator in the threaded hole.

Preload the dial indicator by approx. 3 mm .

Slowly turn the crankshaft counter to the direction of engine rotation, until the needle on the dial indicator no longer moves.

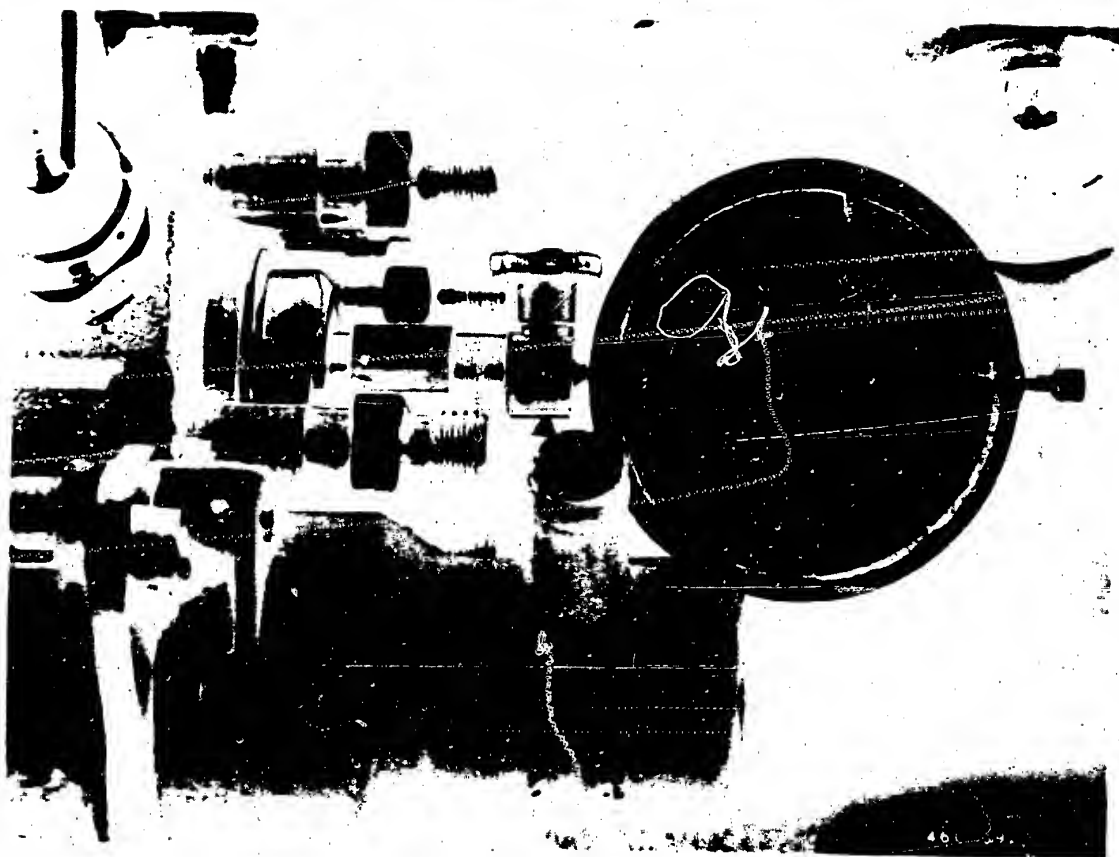
Set the dial indicator at "0".

**F5**

Injection timing

Fiat Argenta 2500 Turbo-Diesel





Turn the crankshaft in the direction of engine rotation, until the TDC-mark on the clutch housing aligns with the reference mark "PMS-1" on the flywheel.

In this position, the dial indicator must show a pump plunger stroke of 0.90 mm ABDC.

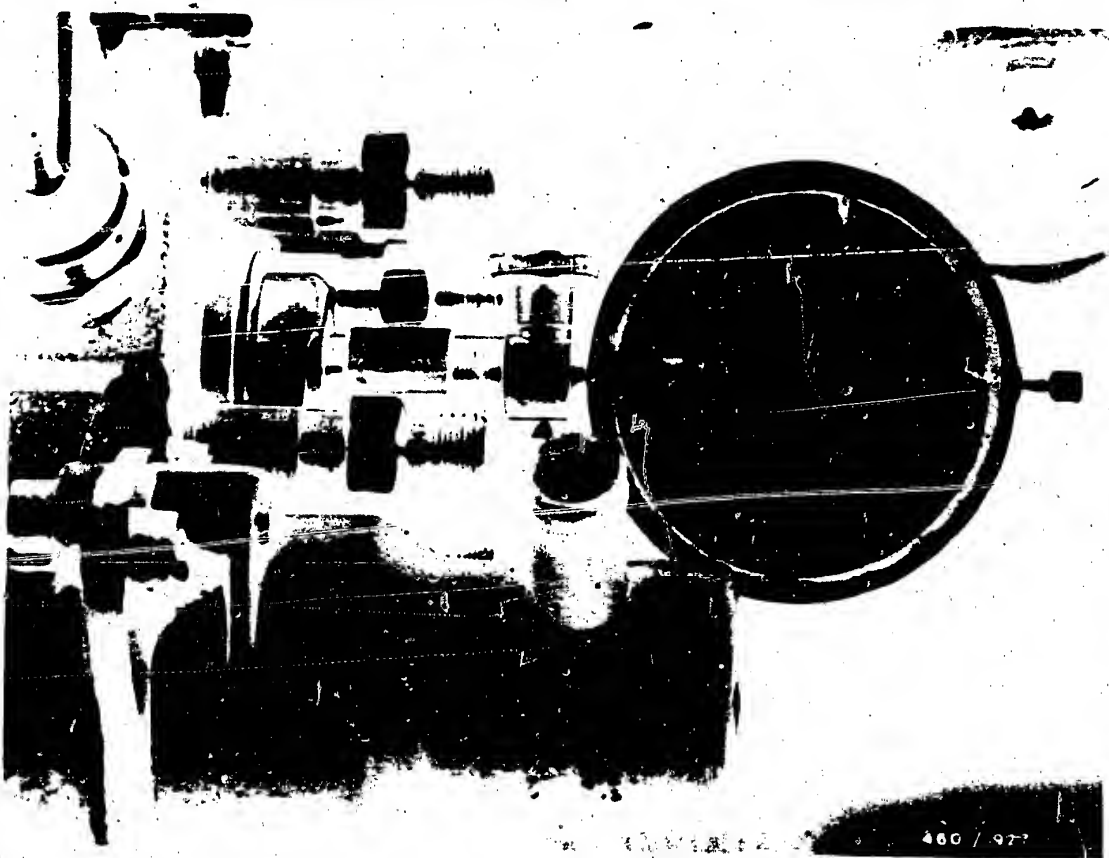
**F6**

Injection timing

Fiat Argenta 2500 Turbo-Diesel







If a correction is needed, loosen fastening screws on the fuel-injection pump.

Pivot the fuel-injection pump until a pump piston stroke of 0.90 mm ABDC is reached.

Tighten fastening screws to 25 Nm.

Rotate crankshaft twice and re-check the adjustment.

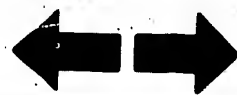
Remove measuring tool KDEP 1085 and dial indicator.

Mount bleeder screw using a new seal ring.

**F7**

Injection timing

Fiat Argenta 2500 Turbo-Diesel





Pull control lever (3) with intermediate piece (2) toward hydraulic head.

Turn intermediate piece (2) through 90° and push again toward drive shaft.

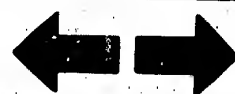
Intermediate piece is in starting position (picture).

Tighten clamping screw (1).

**F8**

Injection timing

Fiat Argenta 2500 Turbo-Diesel



Put on the cylinder head cover and the toothed-belt guard case.

Tighten fuel-injection lines using box wrench KDEP 1115. (Keep the delivery valve holders from turning by holding them with a wrench).

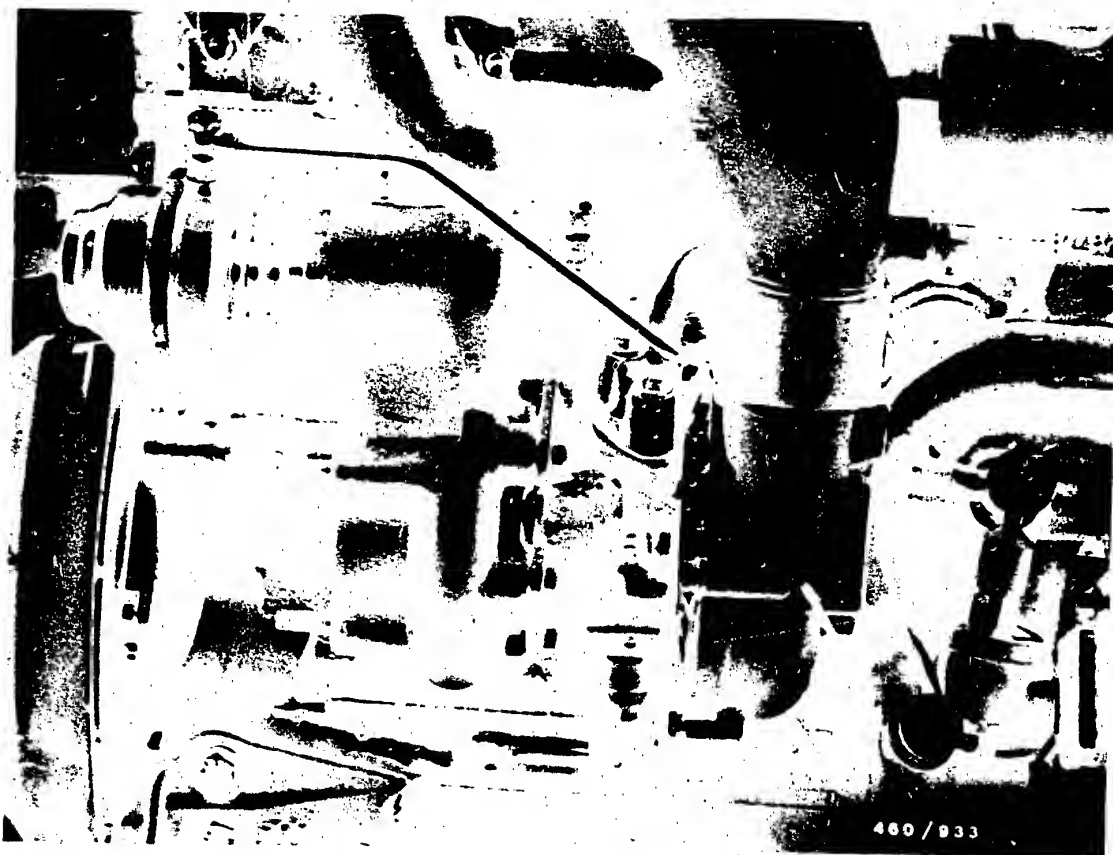
Bleed the fuel system.

**F9**

Injection timing

Fiat Argenta 2500 Turbo-Diesel





### 28. Test charge-air pressure

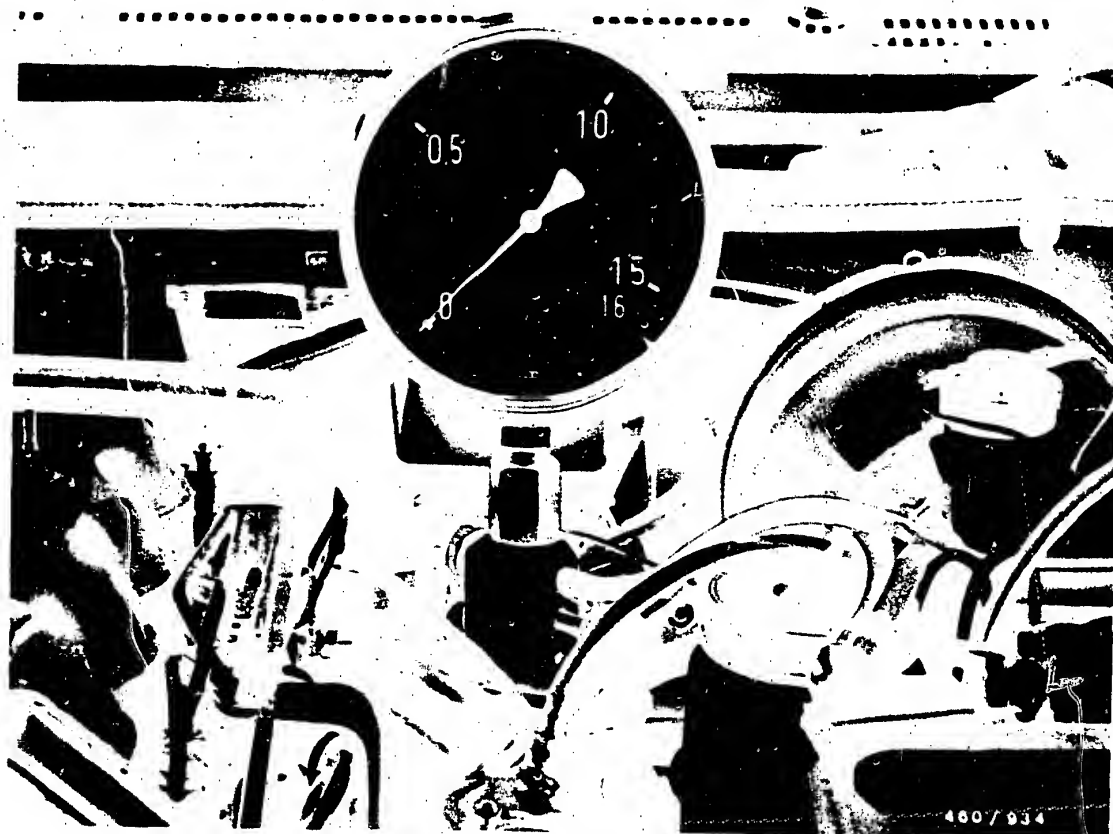
When working on the turbocharger, it should be noted that even the smallest particles of dirt can lead to the destruction of the turbocharger. Therefore, never operate the engine without air filter.

**F10**

Test charge-air pressure

Fiat Argenta 2500 Turbo-Diesel



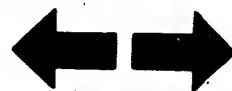


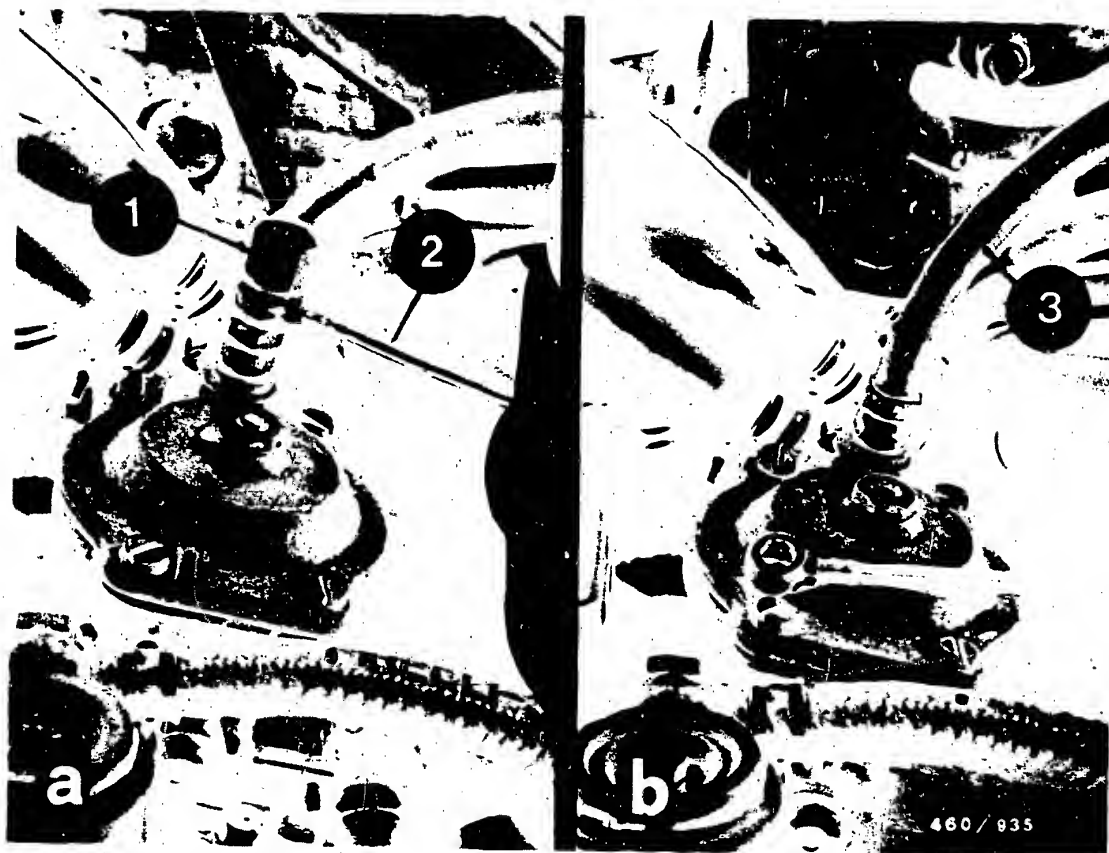
To test the charge-air pressure, it is possible to use the pressure tester KDJE-P 100 or a pressure gauge 0...1,6 bar (e. g. Wika No. 4184).

**F11**

Test charge-air pressure

Fiat Argenta 2500 Turbo-Diesel





### 28.1 Mounting the pressure gauge for measuring the charge-air pressure

Unscrew the screw plug (1).

Remove the pressure line (2) to the charge-air pressure indicating instrument.

Put the pressure gauge connecting hose (3) on the threaded connector.

When charge-air pressure has been measured, use new seal rings.

## 28.2 Measuring the charge air pressure

The charge-air pressure is measured at full load, if possible on chassis dynamometer, at  $4100 \text{ min}^{-1}$

Read off charge-air pressure on pressure gauge.

Set value: 0,87 bar

### Note:

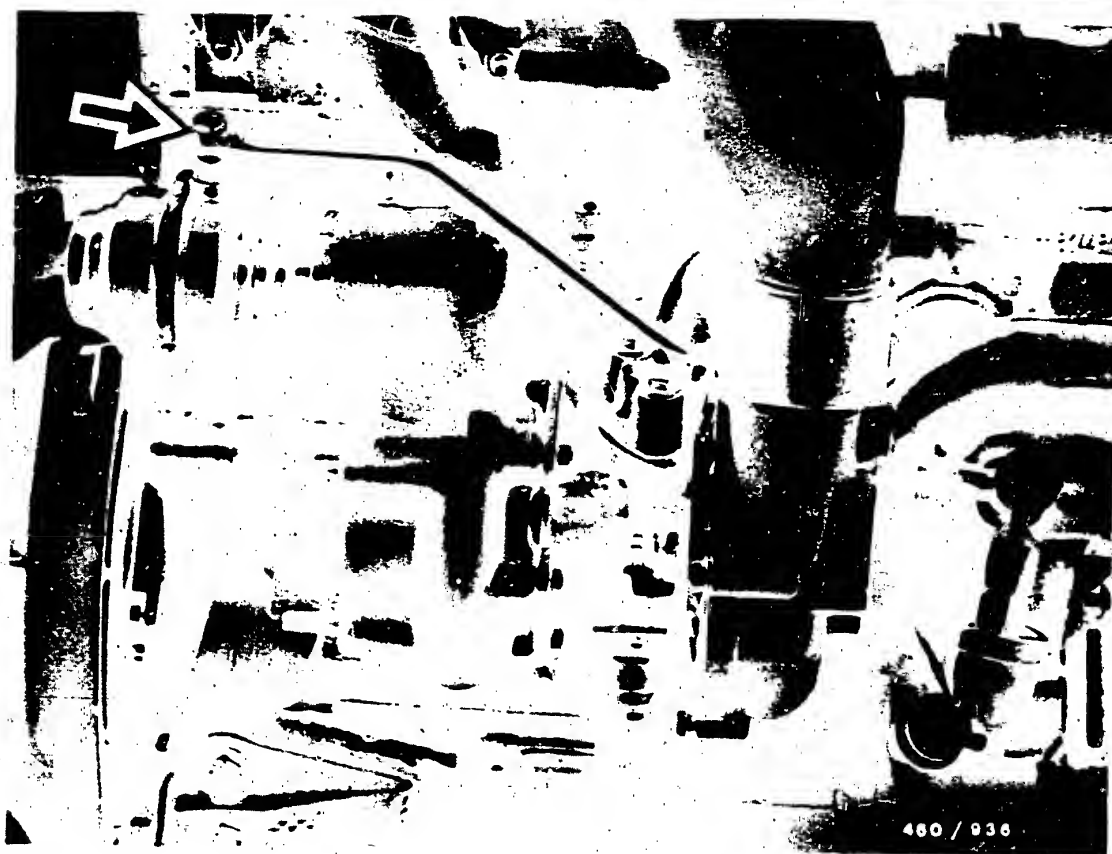
To assess the exhaust-gas turbocharger, it is essential that the start of delivery and nozzle-opening pressure be correctly set, that the air-intake and exhaust systems do not have any leaks, and that the engine (valve clearance, compression pressure) is in good mechanical condition.

**F13**

Test charge-air pressure

Fiat Argenta 2500 Turbo-Diesel





### 28.3 Charge-air pressure too high

Cause of charge-air pressure being too high :

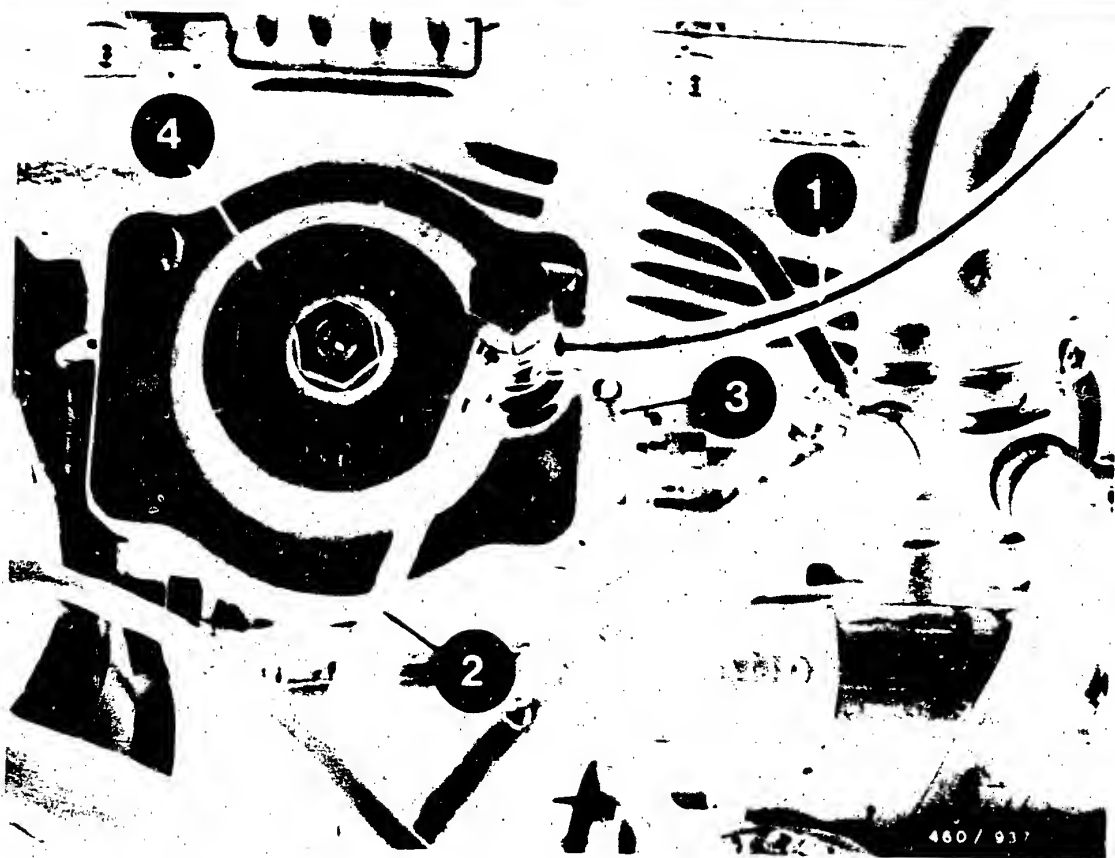
- Line to the wastegate (arrow) leaks.
- Wastegate diaphragm defective \*
- Wastegate valve seized, closed \*
- Wastegate valve incorrectly set \*
- \* Replace turbocharger.

#### Note:

After installing a new turbocharger, fill turbocharger with oil and allow engine to idle for approx. 1 minute so that there is a guaranteed supply of oil to the turbocharger.



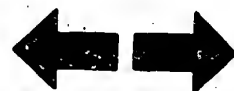


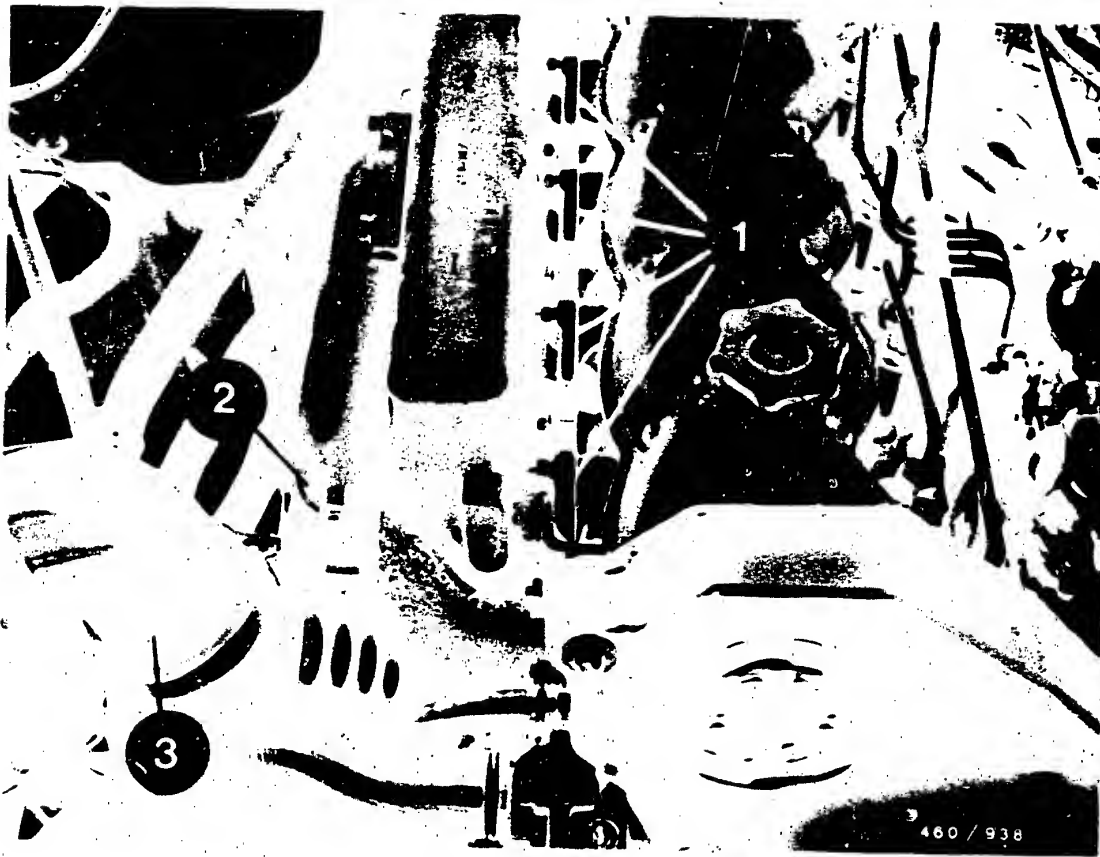


#### 28.4 Charge-air pressure too low

If the charge-air pressure is too low, check the following locations for leaks:

- Pressure line (1) between the charge-air pipe and the manifold-pressure compensator (fuel-injection pump).
- Pressure line (2) between the manifold-pressure compensator and the charge-air pressure indicator instrument.
- The air line (3) to the manifold-pressure compensator may be clogged.
- Diaphragm in the manifold-pressure compensator (4).





- Seal between charge-air tube and engine block (1).

Connecting hose between compressor outlet and charge-air tube (2).

Further causes of charge-air pressure being too low:

- Air filter (3).
- Wastegate incorrectly set \*
- Turbine wheel shaft tending to seize. \*
- Exhaust system clogged.

\* Replace turbocharger.



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